

CHAPTER 5: ENVIRONMENTAL CONSEQUENCES

This chapter provides the scientific and analytical base for the comparison of the alternatives. Approaches used for addressing potential impacts are presented in Section 5.1.

The three alternatives analyzed in this *Site-wide Environmental Impact Statement for Continued Operation of Lawrence Livermore National Laboratory and Supplemental Stockpile Stewardship and Management Programmatic Environmental Impact Statement* (LLNL SW/SPEIS) are the No Action Alternative (Section 5.2), Proposed Action (Section 5.3), and Reduced Operation Alternative (Section 5.4). Fifteen environmental resource elements are analyzed for each alternative:

- Land Uses and Applicable Plans
- Socioeconomic Characteristics and Environmental Justice
- Community Services
- Prehistoric and Historic Cultural Resources
- Aesthetics and Scenic Resources
- Geology and Soils
- Biological Resources
- Air Quality
- Water
- Noise
- Traffic and Transportation
- Utilities and Energy
- Materials and Waste Management
- Human Health and Safety
- Site Contamination

Bounding accident scenarios are presented in Section 5.5 and mitigation measures are discussed in Section 5.6.

The impact analysis for this LLNL SW/SPEIS is based on the best data currently available. This LLNL SW/SPEIS will serve as a baseline document for the preparation of subsequent, tiered *National Environmental Policy Act* (NEPA) documents that may be required prior to implementation of future specific projects.

5.1 METHODOLOGY

The following paragraphs are brief descriptions of the impact assessment approaches used in the LLNL SW/SPEIS for addressing potential impacts of Lawrence Livermore National Laboratory (LLNL) operations under the No Action Alternative, Proposed Action, and Reduced Operation Alternative. Methodologies used for each resource area are discussed below to identify and, if possible, measure potential impacts.

5.1.1 Land Uses and Applicable Plans

To estimate possible impacts of the No Action Alternative, Proposed Action, and Reduced Operation Alternative, the land use analysis relied on information for current and planned facilities presented in Chapter 3 and Appendix A of this LLNL SW/SPEIS. A comparative methodology was used to determine land use impacts from the project alternatives in terms of function and acreage. Facility operations and particularly any facility construction activities were examined and compared to existing land use conditions. Impacts, if any, were identified as they relate to changes in land ownership and land use classifications as well as conflicting uses.

5.1.2 Socioeconomic Characteristics and Environmental Justice

The socioeconomic analysis measured the incremental effects from changes in expenditures, income, and employment associated with the No Action Alternative, Proposed Action, and Reduced Operation Alternative at LLNL, as well as their overall effect on the region of influence (ROI). The ROI, as described in Chapter 4 of the LLNL SW/SPEIS, is a four-county area surrounding LLNL where 93 percent of LLNL employees and their families live, spend their wages and salaries, and use their benefits. Impacts for the Livermore Site were analyzed in combination with those for Site 300 for population and housing because of the overlap in employee residence locations, and because employee statistics for non-LLNL employees are not available by individual site.

Spending by LLNL directly affects the ROI in terms of dollars of expenditures gained or lost for individuals and businesses, dollars of income gained or lost to households, and the number of jobs created or lost. Changes in employment at LLNL directly affect the overall economic and social activities of the communities and people living in the ROI. These changes directly affect the amount of income received by individuals and businesses. Businesses and households in the ROI respond LLNL money, which creates indirect socioeconomic effects from LLNL operations. Every subsequent responding of money by businesses and households in the ROI is another tier of indirect and induced socioeconomic effects originating from LLNL operations.

The analysis compared the magnitude of LLNL employment changes to the year 2014 with future employment, population, and housing levels. Determination of impacts was based on the percentage of these future levels that are attributable to LLNL influence.

Estimates of the geographic distribution of residences of potential new hires associated with the No Action Alternative, Proposed Action, and Reduced Operation Alternative were based on the existing distribution of the workforce residences. This demographic pattern could change over the project period due to various economic and quality of life factors. Indeed, a trend toward more employees living outside of the nearby communities of Livermore and Pleasanton has been

observed in the past 11 years. From 1991 to 2002, the percentage of LLNL employees living in Livermore and Pleasanton has decreased from 49.3 percent to 43.2 percent. Only part of the redistribution has been to the Central Valley cities of Tracy, Manteca, Modesto, and Stockton (17.5 percent in 1991 increasing to 18.7 percent in 2002), as employees balance factors such as housing costs, commute times, and quality of schools. For purposes of this analysis, no change in the distribution was assumed because there could be limiting factors to redistribution such as significantly longer commute times from traffic congestion, the calculations of which were beyond the scope of this LLNL SW/SPEIS.

The potential for disproportionately high and adverse human health or environmental impacts from the alternatives on minority and low-income populations was examined in accordance with Executive Order (EO) 12898, *Federal Action to Address Environmental Justice in Minority Populations and Low-Income Populations* (59 FR 7629). Both the *Environmental Justice Guidance Under the National Environmental Policy Act* (CEQ 1997) and the *Guidance for Incorporating Environmental Justice Concerns in EPA's NEPA Compliance Analyses* (EPA 2002a) provide guidance for identifying minority and low-income populations and determining whether the human health and environmental effects on these populations are disproportionately high and adverse. The environmental justice analysis presents selected demographics and identifies the locations of minority and low-income populations living within a 50-mile radius of LLNL.

5.1.3 Community Services

The community services analysis measured effects on four local government support services: fire protection and emergency services, police protection and security services, school services, and nonhazardous solid waste disposal.

The analysis evaluated the burden placed on each of these support services by changes in LLNL demands under the No Action Alternative, Proposed Action, and Reduced Operation Alternative. In the case of impacts to school services resulting from changes in LLNL staffing levels, the analysis directly examined the increases or decreases in the number of children of LLNL employees attending schools. For the other community services, the analysis relied on indirect indicators of service needed, as data does not support the establishment of a relationship between activities under each alternative and demand for these services. In the case of fire protection, the analysis assumed changes in the demand for service would be proportional to gross square footage of usable floorspace across LLNL. In the cases of police protection and nonhazardous solid waste disposal, the analysis assumed changes in demand for service would be proportional to the number of LLNL employees.

5.1.4 Prehistoric and Historic Cultural Resources

Section 106 of the *National Historic Preservation Act* (NHPA) and its implementing regulations (36 CFR Part 800) state that an undertaking has an effect on a historic property when that undertaking may alter those characteristics of the property that qualify it for inclusion in the National Register of Historic Places (NRHP). An undertaking is considered to have an adverse effect on a historic property when it diminishes the integrity of the property's location, design, setting, materials, workmanship, feeling, or association.

Adverse effects include, but are not limited to:

- Physical destruction, damage, or alteration of all or part of the property
- Isolation of the property or alteration of the character of the property's setting when that character contributes to the property's qualifications for the NRHP
- Introduction of visual, audible, or atmospheric elements that are out of character with the property, or changes that alter its setting
- Neglect of a property resulting in its deterioration or destruction
- Transfer, lease, or sale of a property, without adequate provision to protect the property's historic integrity

The analysis addressed potential impacts or effects to NRHP-eligible resources located within the boundaries of the Livermore Site and Site 300. Proposed activities under the three alternatives were reviewed to identify those that would cause ground disturbance, introduce visual or audible changes, or make changes to existing buildings and structures. The proposed activities were then analyzed to determine if they would cause adverse effects to NRHP-eligible resources.

To fulfill its responsibilities under the NHPA, a Programmatic Agreement has been developed among the National Nuclear Security Administration (NNSA), the Advisory Council on Historic Preservation (ACHP), the California State Historic Preservation Officer (SHPO), and LLNL (Appendix G). The Programmatic Agreement is a guideline for NNSA to comply with Section 106 for all present and future actions until management plans are completed and this interim Programmatic Agreement is superseded by an agreement to implement the plans. The Programmatic Agreement was signed on July 11, 2003. Provisions of the Programmatic Agreement would serve as components of mitigation measures.

5.1.5 Aesthetics and Scenic Resources

The aesthetics and scenic resources analysis looked at the construction and operation of facilities described under the No Action Alternative, Proposed Action, and Reduced Operation Alternative and the resulting effects to the visual quality of the ROI. The ROI includes the Livermore Site and Site 300, as well as the view shed immediately surrounding these two areas.

The analysis of impacts to aesthetics and scenic resources used a comparative methodology and included a qualitative examination of potential changes to view sheds and viewpoints. Proposed activities under the No Action Alternative, Proposed Action, and Reduced Operation Alternative that would result in a change to the built environment on the Livermore Site and Site 300 were of particular interest. Construction of new facilities, extensive modification of existing facilities, and demolition of existing facilities associated with each alternative were examined, and any resulting changes were analyzed for potential impact to the existing aesthetic and scenic environment. Analysis focused on site development or modification activities that would alter the visibility of LLNL structures, obscure views of the surrounding landscape, or conflict with aesthetics or scenic resources in the surrounding area.

5.1.6 Geology and Soils

The geology and soils analysis looked at the effects of the construction and operation of facilities and of activities described in the No Action Alternative, Proposed Action, and Reduced Operation Alternative in the ROI. The ROI includes the lands occupied by and immediately surrounding the Livermore Site and Site 300.

The analyses evaluated the amount of disturbance that might affect the geology and/or soils of areas at the Livermore Site and Site 300. Impacts could include erosion and effects to potential geologic economic resources, such as mineral and construction material resources and fossil locations. In general, impacts to soils were defined as taking areas with soils that support agriculture out of production. Impacts to soils were quantified as the amount of area disturbed by construction activities. Impacts are evaluated and the severity of impacts are determined. Possible mitigation is identified for adverse impacts.

The seismicity of the region surrounding each site was evaluated to provide perspective on the probability and severity of future earthquakes in the area. This information was used to provide input to the evaluation of accidents due to natural phenomena.

5.1.7 Biological Resources

A qualitative analysis addresses the impacts of the activities under each alternative to biological resources. The methodology focused on those biological resources with the potential to be appreciably affected, and for which analyses assessing alternative impacts were possible. Biological resources include vegetation, wildlife, protected and sensitive species, and wetlands that are present or use the Livermore Site, Site 300, and contiguous areas. The potential sources of impacts from normal operations and security measures to biological resources that were considered include noise, outdoor tests, erosion, construction, demolition, and prescribed burns.

The biological data from earlier projects, wetlands surveys, and plant and animal inventories of portions of the Livermore Site and Site 300 were reviewed to identify the locations of plant and animal species and wetlands. Lists of sensitive species potentially present on the Livermore Site and Site 300 and areas designated as critical habitat were obtained from the U.S. Fish and Wildlife Service (USFWS). A similar request was made to the California Department of Fish and Game.

Activities and potential releases identified under the No Action Alternative, Proposed Action, and Reduced Operation Alternative were reviewed for their potential to affect plants, animals, and the sensitive species under Federal and state laws and regulations. Potential beneficial and negative impacts to plants and animals were evaluated for gain, loss, disturbance, or displacement. Impacts to wetlands were evaluated to determine if their areal extent would change. Monitoring data on sensitive plants and animals were reviewed for impact to these resources.

5.1.8 Air Quality

5.1.8.1 Nonradiological Air Quality

The primary activities that emit air pollutants, associated with current and continued laboratory operations, include fuel combustion, vehicular activity particularly with employees commuting to and from the site, and construction and maintenance activities. Air pollutant emission rates and potential impacts of these activities were assessed using standard methods endorsed by the U.S. Environmental Protection Agency (EPA) and local air pollution control agencies. As available, site-specific parameters developed by local air quality regulatory agencies were incorporated and conservative assumptions were used so as not to underestimate the potential impact.

The assessment of impacts from increased vehicular activity follows a methodology developed by the Bay Area Air Quality Management District (BAAQMD) in conjunction with the California Air Resources Board (CARB), Association of Bay Area Governments (ABAG), and the Metropolitan Transit Commission. The method took into account the current and projected typical mix of vehicles (fleet type and age), gasoline formulations, ambient temperature, effectiveness of vehicle inspection and maintenance programs, typical driving habits, the impact of planned regulatory program requirements for more efficient engines and cleaner burning fuels, and reduction in vehicle miles traveled resulting from planned transportation demand management. In addition to estimating emissions from vehicles, maximum potential carbon monoxide concentrations are assessed along congested corridors to determine whether increased motor vehicle use associated with new projects would contribute to a carbon monoxide level that would exceed ambient air quality standards. This assessment considered projected peak hourly traffic volumes along Vasco Road and Patterson Pass Road, which serve the major flow of traffic to LLNL.

As a final assessment, total emissions from project operations (including motor vehicle emissions) were compared to significance and conformity levels. Annual and daily significant emission levels are established by local air districts in response to local air quality concerns. By evaluating project emissions as a whole, including motor vehicle emissions, this affords the air district a greater level of control over a project not limited to source permitting. A project that generates criteria air pollutant emissions in excess of the significance levels would be considered to have a significant air quality impact and stringent mitigation would be required. Rules for conformity also consider total project emissions. These rules were established under the Federal *Clean Air Act* (CAA) and pertain specifically to Federal actions. The underlying basis for the conformity demonstration is to preclude actions that would generate growth in air pollutants to a degree that is inconsistent with the local clean air plan, and thereby frustrate regional efforts to attain and maintain the National Ambient Air Quality Standards (NAAQS). Within the Bay Area, projects that generate emissions of precursor organic compounds, oxides of nitrogen, or carbon monoxide in excess of 100 tons per year are required to fully offset or mitigate the emissions caused by the action (BAAQMD 1999).

In addition to operational emissions, construction activities, although generally short-term in duration, can cause substantial increases in localized concentrations of particulates. Particulate emission rates vary greatly depending on the level of activity, the specific operations taking

place, the equipment being operated, local soils, weather conditions and other factors. Despite this variability in emissions, experience has shown that there are a number of feasible control measures that can be reasonably implemented to significantly reduce particulate matter emissions from construction. The BAAQMD's approach to analyses of construction impacts relative to significance levels is to emphasize implementation of effective and comprehensive control measures rather than detailed quantification of emissions. From the district's perspective, quantification of construction emissions is not necessary; the determination of significance with respect to construction emissions should be based on a consideration of the control measures to be implemented (BAAQMD 1999). However, a conformity analysis requires quantification of construction related emissions.

The BAAQMD has identified a three-tiered set of feasible control measures designed to reduce emissions of respirable sized particulates (PM_{10}) from construction activities: Basic Measures should be implemented at all construction sites, regardless of size; Enhanced Measures should be implemented at larger construction sites (greater than 4 acres) where PM_{10} emissions generally would be higher; and Optional Measures may be implemented if further emission reductions are deemed necessary by local agencies. If all of the control measures depending on the size of the project area would be implemented, then air pollutant emissions from construction activities would be considered a minor impact. Similarly, any demolition, renovation, or removal of asbestos-containing building materials would be considered a minor impact if the activity complies with the requirements and limitations of BAAQMD Regulation 11, Rule 2: Hazardous Materials, Asbestos Demolition, Renovation and Manufacturing (BAAQMD 1999).

5.1.8.2 *Radiological Air Quality*

Routine radiological emissions from LLNL facility operations were evaluated on the basis of dose to the site-wide maximally exposed individual (MEI) and collective dose to the general population within 50 miles of the site (population dose). Section 5.1.14 presents further information on health effects from nonradiological and radiological emissions. The MEI evaluation was compared to the National Emissions Standards for Hazardous Air Pollutants (NESHAP) (40 CFR Part 61). NESHAP limits the radiation dose that a member of the public may receive from radiological material released to the atmosphere from normal operations to 10 millirem per year. Although there is no standard that governs population dose, it is compared with the population dose received from naturally occurring radiation.

The baseline year for radiological emissions was taken as 2002. The effect of perturbations to individual facility emissions on MEI dose for the various alternatives was considered by scaling the baseline facility dose given in the *LLNL NESHAP 2002 Annual Report* (LLNL 2003z). The contribution of new facilities or releases (e.g., the National Ignition Facility [NIF]) on MEI dose and location was calculated using the EPA-approved *Clean Air Assessment Package* (CAP88-PC 2000) computer model. CAP88-PC, used also in the NESHAP annual report, conservatively calculates radiological impacts extending up to 50 miles. Doses from both internal (e.g., inhalation, ingestion of foodstuffs) and external exposure (e.g., standing on ground contaminated with radioactive material) were considered. Spatial population distributions at each site were based on 2000 data. Agricultural data used were for the State of California, as contained in the CAP88-PC database. It was assumed that the entire source of ingested vegetables and meat is

grown within the affected area. No milk production was found in the area; all milk was assumed imported from outside the area.

The MEI is a hypothetical member of the public assumed to be located outdoors in a public area where the radiation dose from a particular source is highest. This individual is assumed to be exposed to the entire plume in an unshielded condition. The impacts on the MEI are therefore greater than the impacts that any member of the public can be expected to receive. The site-wide MEI is located where the composite dose from all site sources is greatest. The two LLNL sites, Livermore Site and Site 300, are far enough apart that the site-wide MEI from each does not affect the other. A separate site-wide MEI is defined for each of the two LLNL sites. Similarly, separate collective doses to the population are noted for each of the two sites. Since there is overlap in the affected site populations, a composite collective dose is also noted.

5.1.9 Water

Surface Water

The affected environment discussion includes a description of local surface water resources at the Livermore Site and Site 300, flow characteristics and relationships, and existing water quality. Data used for impact assessments included rates of water consumption and wastewater discharge. The existing water supply was evaluated to determine if sufficient quantities were available to support an increased demand by comparing projected increases with the capacity of the supplier.

The water quality of potentially affected receiving waters was determined by reviewing current monitoring data for contaminants of concern. Potential impacts from releases of radioactive materials are discussed in Appendix C, Section C.4, Environment, Safety, and Health. Focus was given to parameters that exceeded applicable water quality criteria as determined by the State of California. Monitoring reports for discharges permitted under the National Pollutant Discharge Elimination System (NPDES) were examined for compliance with permit limits and requirements. The assessment of water quality impacts from wastewater (sanitary and process) and stormwater runoff addressed potential impacts to the receiving waters' average flow during construction and operation. Suitable mitigation measures for potential impacts such as stream channel erosion, sedimentation, and stream bank flooding were identified.

Floodplains were identified to determine whether any of the proposed facilities would be located within the 100-year and 500-year floodplains.

Groundwater

Groundwater resources were analyzed for effects on aquifers, groundwater use and storage, and groundwater quality within the regions. Groundwater resources were defined as the aquifers underlying the site and their extensions downgradient, including discharge points. The affected environment discussion included a description of the local hydrogeology, occurrence, flow, and quality. Groundwater usage was described and projections of future usage were made based on changing patterns of usage and anticipated growth patterns.

Available data on existing groundwater quality were compared to Federal and state groundwater quality standards, effluent limitations, and safe drinking water standards. Additionally, Federal and state permitting requirements for groundwater withdrawal and discharge were identified. Impacts of groundwater withdrawals on existing contaminant plumes due to construction and facility operations were assessed to determine the potential for changes in their rates of migration and the effects of any changes in the plumes on groundwater users. Impacts were assessed by evaluating local hydrogeology, groundwater quality, and groundwater availability.

5.1.10 Noise

Various activities at LLNL result in noise that may be heard in surrounding offsite locations. To understand the potential impact of planned or proposed activities, noise levels attributed to activities such as construction, demolition, and operating equipment were characterized in terms of decibel level and described in relation to comparative noise levels of activities commonly encountered in community settings and land use compatibility guidelines. For noncontinuous sources, such as construction, demolition, and the unique impulse noise associated with explosives firings, activity levels were provided to give a sense of the amount of time that intermittent sources would be operated and contribute to ambient noise levels. Source location is also discussed where proximity to community receptors would result in a higher likelihood that a source would be heard in offsite areas.

5.1.11 Traffic and Transportation

NNSA selected traffic congestion and collective radiation dose and latent cancer fatalities (LCFs) to the general population as analytical endpoints for the transportation analysis. Traffic congestion was determined by qualitatively comparing current traffic levels with projected employment changes for the various alternatives. Radiological doses from transport of radioactive materials and wastes were calculated by computer modeling. The radiological transportation analysis methodology is summarized below. Appendix J, Radiological Transportation Analysis Methodology, provides additional information on methods and assumptions for the radiological transportation analysis.

All transportation of radioactive materials was assumed to take place by truck. LLNL identified origin-destination pairs for each shipment campaign. NNSA then used the Transportation Routing Analysis Geographic Information System (TRAGIS) computer code (ORNL 2000) to determine the most suitable routing. TRAGIS was constrained to only provide routes consistent with the U.S. Department of Transportation's highway route-controlled quantity regulations. Besides identifying the route, TRAGIS provided useful inputs to the remainder of the modeling such as miles per population density category and population within 800 meters of the route for each state and population density category.

NNSA then used the U.S. Department of Energy (DOE) code, RADTRAN 5 (SNL 2000), to calculate incident-free radiological impacts (normal transport without any accident releasing radioactive materials) to a member of the public. Members of the public are those residing within 800 meters of the route, those sharing the route in other vehicles, and those near the shipment at rest stops. Besides route length and demographics, the radiation dose 1 meter from the truck was the most important parameter. NNSA used a dose rate of 1 millirem per hour for shipments of

special nuclear material and low-level waste (LLW) and 4 millirem per hour for transuranic (TRU) waste. RADTRAN 5 was used to calculate the collective dose for each type of material shipped between the various origin-destination pairs. The results were then multiplied by the numbers of shipments for each campaign.

For accidents, NNSA used RADTRAN 5 to calculate the collective dose should an accident occur. NNSA conservatively selected the highest consequence accident in the most populated area to report.

Collective doses from incident-free and accident analyses were multiplied by the conversion factor for converting collective dose to numbers of LCFs. This factor is 6×10^{-4} LCFs per person-rem, as determined by the Interagency Steering Committee on Radiation Standards (Lawrence 2002).

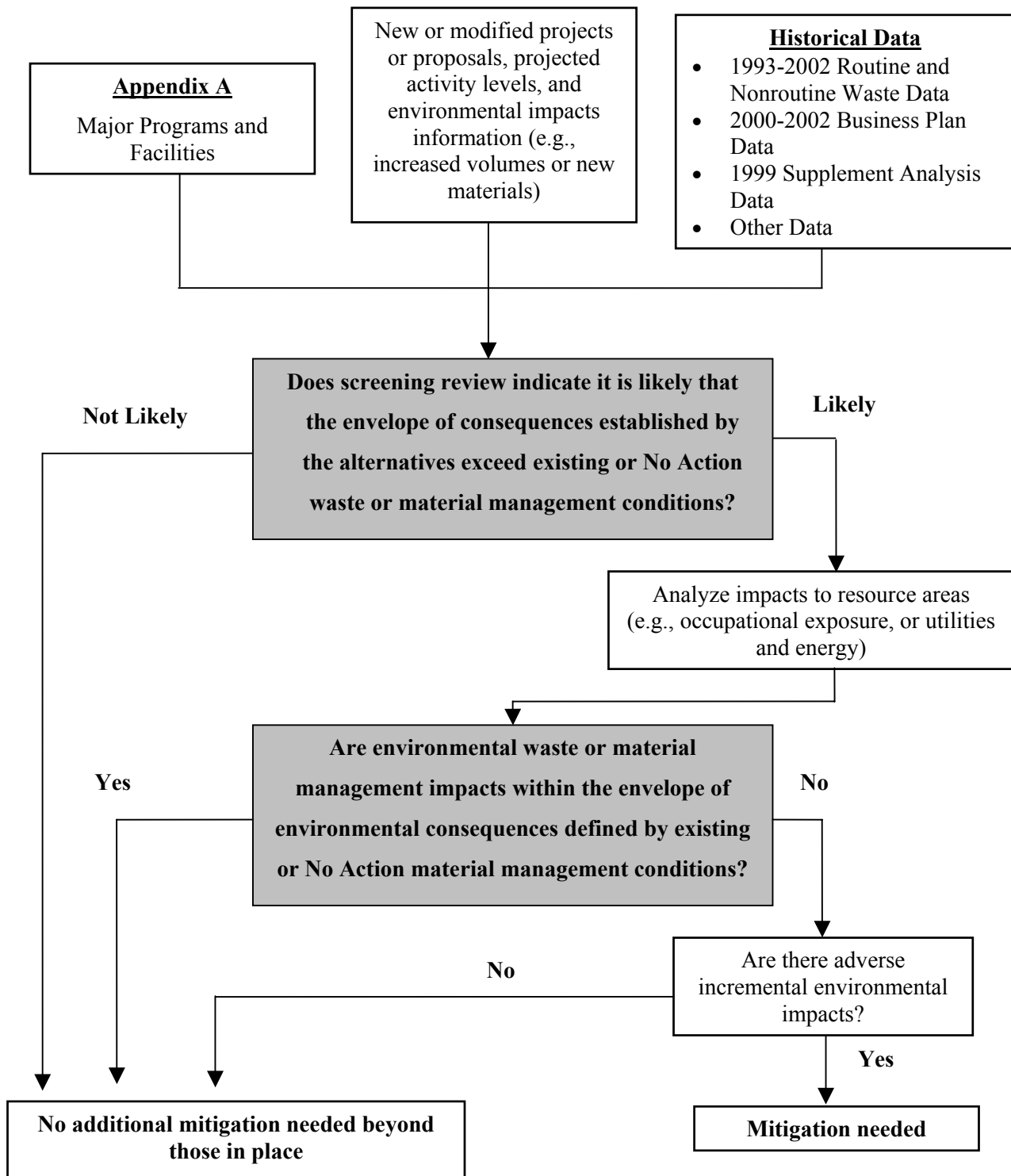
5.1.12 Utilities and Energy

Incremental changes to utilities and energy use at both the Livermore Site and Site 300 were assessed by comparing the support requirements of the alternatives to current site utility demands (e.g., water, sewer, electricity, fuel) based on projected square footage requirements and available capacities. Utility usage at each site was adjusted for contributions from the selected facilities and program projections. Two programs, the NIF and the Terascale Simulation Facility, were specifically evaluated for impacts. Impacts of other facilities and programs were evaluated based on average use per square foot.

5.1.13 Materials and Waste Management

Materials include chemicals, radioactive materials, or explosives that were used by LLNL in operations or research. Materials do not include waste. The methodology used to determine environmental impacts of the proposed alternatives on waste and materials management involves a three-step screening analysis as illustrated in Figure 5.1.13–1.

- Step 1 performs an initial screening analysis of new or modified projects or proposals, historical data, projections based on activity levels, permit modifications, changed circumstances, and new regulations. The initial screening analysis determines the specific environmental impact categories (e.g., air quality) that may exceed the bounds of the affected environment (existing conditions), as described in Section 4.15, Materials and Waste Management.
- Step 2 analyzes those impact categories that are likely to exceed the material and waste management existing or No Action Alternative conditions.
- Step 3 assesses the material and waste management to determine the environmental consequences of the increase or decrease to the affected environment or No Action Alternative.

FIGURE 5.1.13–1.—*Waste and Materials Management Methodology Flowchart*

The material management analysis examined potential impacts associated with material handling, management, and storage activities at LLNL, including radioactive materials, explosives, and hazardous chemicals. Impacts from nonhazardous materials are not discussed due to reduced risk to human health and the environment. The ongoing material management practices related to handling, using, and storing materials are described below. The analysis also considered the regulatory framework as it applies to material management and a summary of current and projected material management activities. Selected facilities or activities that use materials were evaluated for changes in the existing or No Action Alternative operations quantity of materials used as a result of the alternatives. LLNL storage capacities were evaluated for any impacts on their capabilities to manage materials before receipt. The analysis of potential impacts considered physical safety, regulatory requirements, and security measures associated with storage capacity, personnel safety, and usage capacity.

The waste management analysis examines potential impacts associated with waste generation activities at LLNL, including LLW, mixed low-level waste (MLLW), TRU, mixed TRU, hazardous waste, *Resource Conservation and Recovery Act* (RCRA) construction waste, decontamination and decommissioning (D&D) waste, municipal solid waste, and process (including domestic) wastewater. The ongoing waste management practices relating to generating, handling, treating, permits modifications, and storing wastes are described. The analysis also presents a summary of the regulatory framework as it applies to waste management and a summary of current and projected waste generation activities. Selected facilities or activities that generate waste were evaluated for changes in the existing or No Action Alternative quantity of waste generated as a result of the alternatives. LLNL treatment and storage facilities were evaluated for any impacts on their capabilities to manage wastes before transportation to offsite disposal. At LLNL, several organizations manage waste at waste management facilities including Plant Engineering, Chemistry and Materials Science Directorate, and the Radioactive and Hazardous Waste Division. For simplicity, the term Radioactive and Hazardous Waste Management (RHWM) covers all of these organizations. The analysis of potential impacts considered physical safety, regulatory requirements, and security measures associated with storage capacity, personnel safety, and treatment capacity.

A quantity projected under the No Action Alternative represents the maximum average quantity reported for any year during the 10-year timeframe 1993-2002. Waste volume and material maximum inventory estimates are considered to be conservative and bounding based on current annual projections.

For each selected facility, the waste and material quantity projected under the Proposed Action represents the maximum possible waste and material generation level, and thus the bounding level of operation. This applies to all waste types including LLW, MLLW, and hazardous waste and all material types including radioactive, explosive, and chemical.

A quantity projected under the Reduced Operation Alternative represents that of waste generated or material used during any given year as a result of maintaining programmatic capabilities across LLNL at minimum operational levels.

5.1.14 Human Health and Safety

LLNL operations that could potentially impact human health and safety include radiological and nonradiological exposures and occupational injuries, illnesses, and fatalities resulting from normal, accident-free operations on site facilities. Impacts are given in LCFs, emergency response planning guideline (ERPG) values, injury and illness recordable cases, and lost/restricted workday cases. The following paragraphs discuss how each of these human health and safety issues is estimated. Impacts are estimated for involved workers, noninvolved workers, and the public. See Appendix C of this LLNL SW/SPEIS for detailed methodology on human health and safety.

Nonradiological Health Impacts

Occupational Safety

Occupational injuries and illnesses are those incidents that result during the performance of an individual's work assignment. Occupational injury, illness, and fatality estimates were evaluated using site-specific occupational incidence rates. DOE Computerized Accident/Incident Reporting System (CAIRS) and LLNL Occupational Accident/Injury/Illness Analysis Support and Information System (OAASIS) data were used. Projected occupational injury and illness cases were calculated using 2002 data. Occupational injury, illness, and fatality categories used in this analysis were in accordance with Occupational Safety and Health Administration (OSHA) definitions. Incident rates were developed for facility operations.

Hazardous Chemicals (Nonradiological)

Health risks from hazardous chemical releases were not assessed for normal (accident free) operations because the LLNL-measured data for workplace concentrations of hazardous materials (see Appendix C for details) did not indicate the potential for adverse health impacts to involved and noninvolved workers.

Radiological Health Impacts

Radiological health impacts from normal operations were evaluated in terms of the probability of a premature fatality. Such impacts were quantified by noting the probability that a given radiation exposure would result in an LCF to an individual. When evaluated over a population, the individual probabilities can be generalized to make a statement as to how many people (but not which people) in the population would be affected.

The Interagency Steering Committee on Radiation Standards (Lawrence 2002) recommended a risk estimator of 6×10^{-4} excess (above those naturally occurring) fatal cancers per person-rem of dose in order to assess health effects to the public and to workers. The probability of an individual worker or member of the public contracting a fatal cancer is 6×10^{-7} per millirem. Radiation exposure can also cause nonfatal cancers and genetic disorders. The probability of incidence of these is one third that of a cancer fatality (Lawrence 2002).

Worker health effects from occupational exposure to radiation are projected based on recent experience with continuing operations and projections of specific additional operation impacts

on involved workers. The bulk of the dose to involved workers from current operations, approximately 90 percent of total worker dose, is from operations at Building 332. This trend is expected to continue; changes in involved worker dose at LLNL are due chiefly to increased operations in that building (LLNL 2003az). The only exception to this is for increases due to NIF operations. Worker dose from NIF operations is based on operation-specific studies (LLNL 2003d).

Radiological health impacts to the general population were calculated from radiation exposure to the site-wide MEI and the population as a whole. A similar calculation was performed for the noninvolved worker population dose. These doses were converted to health impacts using the dose to risk estimators. The air transport pathway currently results in almost all of the doses to the public from LLNL, either directly or through deposition and subsequent inhalation and ingestion.

5.1.15 Site Contamination

Site contamination analyses focused on two distinct areas: soil contamination and groundwater quality.

The soil contamination analysis considered the potential for human contact of near-surface (the top 6 inches to 1 foot) contaminated soils and limitations on future land use of these areas. The analysis examined the types of sites where soil contamination could be present (environmental restoration and outdoor testing areas) and site characteristics. Soil contaminant concentrations were considered under each alternative and compared with criteria for future designated land use.

The groundwater quality analysis determined to what extent contamination from LLNL sites in the unsaturated and saturated zones would limit the potential use of groundwater, particularly as drinking water. Unsaturated zone and groundwater contamination sites were characterized in terms of their contaminants, concentrations, and extent.

5.2 IMPACTS FOR THE NO ACTION ALTERNATIVE

The No Action Alternative is the continued operation of the Livermore Site and Site 300, including projects for which NEPA analysis and documentation already exists. Programs and projects would continue at their present levels as described in Section 3.2, but no proposed projects would be added except for those funded, which are those required to maintain the existing infrastructure.

The discussion below follows the order of issues presented in Chapter 4. Each section discusses impacts and mitigation measures as appropriate. These sections also discuss cumulative impacts, both locally and regionally, when applicable. See Chapter 3 and Appendix A, Description of Major Programs and Facilities, for a more detailed discussion of all the projects included in the No Action Alternative.

Cumulative impacts result from impacts of the No Action Alternative in combination with impacts of future development, either in the vicinity or within a regional area appropriate to the resource being analyzed. The Livermore Site cumulative air impacts consider the entire air resource region designated by the BAAQMD. Cumulative impacts discussed in this section analyze impacts that result primarily from implementation of the No Action Alternative at LLNL.

5.2.1 Land Uses and Applicable Plans

This section describes the impacts to land uses and applicable plans under the No Action Alternative. Impacts are analyzed for the Livermore Site and Site 300 based on the methodology presented in Section 5.1.

5.2.1.1 *Relationship with Site Operations*

This section summarizes the relationship between projects described in Section 3.1 for the No Action Alternative and the land use impact analysis. In general, the effect of projects for the No Action Alternative on land use would be related to the planned construction and D&D of facilities as part of projects that have been funded, but not yet executed. Changes to operations would not alter land use. No land acquisitions are included under the No Action Alternative, therefore land use changes would be confined to onsite areas.

5.2.1.2 *Impact Analysis*

Livermore Site

Under the No Action Alternative, new facility construction, upgrades, and D&D activities would occur at the Livermore Site. Many of these projects are already underway. While the types of land uses would not change, some infill and modernization would occur. Figure 5.2.1.2–1 shows the locations of new facilities. Most new facilities would be located in the developed portion of the Livermore Site. Table 5.2.1.2–1 provides the estimated area of disturbance for new facility construction in undeveloped areas.

TABLE 5.2.1.2–1.—Area of Disturbance for New Facility Construction Under the No Action Alternative in Livermore Site Undeveloped Areas

Facility	Location	Estimated Area of Disturbance
East Avenue Security Upgrade	Southern border of Livermore Site between LLNL and SNL/CA	172,000 ft ²
Extend Fifth Street	West side of Livermore Site from Avenue A to West Perimeter Drive	132,000 ft ²
International Security Research Facility	Southwest side of Livermore Site near developed area	64,000 ft ² 54,000 ft ² Parking
Remove and Replace Offices	East side of the Livermore Site east of the drainage retention basin	40,000 ft ²
Total		462,000 ft²

Note: This table only includes those facilities with the potential to disturb soil in the undeveloped zones.

LLNL = Lawrence Livermore National Laboratory; SNL/CA = Sandia National Laboratories/California; ft² = square feet.

New structures would be used for the same types of uses as existing facilities, namely research and development (R&D), which is the existing land use designation for all Livermore Site facilities. Therefore, it would not represent a change in land uses, nor lead to a conflict with existing and approved future land uses adjacent to the site. Although the Livermore Site is on Federal land and not subject to local zoning ordinances, LLNL's R&D activities would be compatible with the MP designation (industrial park) in Alameda County and the I-2/I-3 designations (professional and administrative offices/R&D facilities) in the city of Livermore. No new types of land uses would be introduced in the buffer and perimeter areas. Therefore, no change in the site's compatibility with existing and approved future land uses would result from the No Action Alternative and no additional impacts are expected.

New facilities could have secondary effects on land use due to increased personnel and activity at the site. These effects could include additional traffic, noise, vehicular exhaust emissions, demands for community services, increased consumption of natural resources, effects to wildlife habitat, and increased waste generation. These effects are addressed in the other sections of this chapter.

Site 300

The No Action Alternative at Site 300 would include upgrades and consolidation of existing facilities and a D&D project. No land acquisitions would be included. The types of land uses at Site 300 are not proposed to change, and the open space character of the site would be retained. No major alterations in the types of land uses would result.

Land uses at Site 300 would be compatible with the existing land uses and approved land use designations surrounding the site and with policies regarding open space resources near the site. Because activities under the No Action Alternative represent a continuation of existing land uses, they would be compatible with existing and approved future land uses surrounding the site and no additional impacts are expected to occur.

5.2.1.3 Cumulative Impacts

Livermore Site

The cumulative impact study area with regard to land uses and planning programs for the Livermore Site is defined as that area of Alameda County generally east of Tassajara Road in the city of Dublin and Santa Rita Road in the city of Pleasanton, which encompasses the city of Livermore and eastern unincorporated Alameda County. Large undeveloped open space areas in Alameda County exist in the northern, eastern, and southern portions of the county. A majority of the undeveloped areas is used for agricultural purposes, primarily for grazing and viticulture. Agricultural lands in the South Livermore Valley General Plan Amendment area support an active wine industry.

A continuing land use trend in Alameda County has been the encroachment of residential, commercial, and industrial uses on agricultural and open space areas. Developing planned and proposed residential projects would contribute to the cumulative loss of agricultural land and open space. However, the No Action Alternative would not contribute to the cumulative effect on the loss of agricultural land and open space because the Livermore Site is already committed to R&D land uses and no acquisition of open space or agricultural land would be proposed. Minimal impacts to land use are expected to occur.

Site 300

The cumulative impact study area with regard to land uses and planning programs for Site 300 is defined as that portion of San Joaquin County generally south of Interstate 205 (I-205) that encompasses the city of Tracy and southwestern unincorporated San Joaquin County. Land uses in the area south of I-580 in unincorporated San Joaquin County include agricultural (primarily grazing), commercial recreation, and explosives testing facilities, including Site 300.

The city of Tracy, the border of which is located approximately 2 miles northeast of Site 300, has a developed core of residential and commercial uses, which becomes less dense along the outer boundaries of the city. Industrial and agricultural land uses surround the developed part of the city. In 1998, the city of Tracy annexed the Tracy Hills area southwest of I-580, the area of Tracy that is now closest to Site 300. The Tracy Hills planning area is 6,175 acres. In an effort to preserve agricultural land on the valley floor, the city of Tracy Planning Department is encouraging new development in hillside areas such as Tracy Hills (City of Tracy 1993).

A residential community such as Tracy Hills could be compatible with Site 300, depending on the final design and siting of residences. The city of Tracy also has annexed an area of San Joaquin County that is approximately 2 miles from Site 300 and has planned for residential development in this area. The Tracy General Plan (City of Tracy 1993) provides for a conservation or open space area to be established that would be a buffer zone between Site 300 and any potential new development.

Approved and proposed projects in the southwestern San Joaquin County would contribute to a cumulative loss of open space; however, implementation of the No Action Alternative would not contribute to this cumulative loss of open space because no loss of agricultural land or open space would be proposed. No additional impacts are expected to occur.

5.2.2 Socioeconomic Characteristics and Environmental Justice

This section analyzes the socioeconomic impact associated with implementation of the No Action Alternative. The section organizes the impact analysis by employment, and housing and population, with effects delineated by geographic area (counties and cities) within the ROI. Environmental justice issues are also discussed.

5.2.2.1 Relationship with Site Operations

This section summarizes the relationship between projects described in Section 3.1 for the No Action Alternative and the socioeconomic impact analysis. In general, the effect of projects on socioeconomics is related to the additional employment opportunities and expenditures, provided as a result of design, construction, and operation of projects under the No Action Alternative. For the socioeconomic analysis, indirect effects of these changes are also evaluated. Important parameters for the socioeconomic analysis are shown in Table 5.2.2.1–1.

**TABLE 5.2.2.1–1.—Input Parameters for Socioeconomic Analysis
Under the No Action Alternative**

Parameter	Units	Site	Existing Environment	No Action Alternative
Employment	Number of personnel	LLNL	10,360 (all site workers)	10,650 (all site workers)
		Livermore Site	8,610 (LLNL employees) 17,000 (LLNL employees and indirect)	8,900 (LLNL employees) 17,500 (LLNL employees and indirect)
		Site 300	240 (LLNL employees) 470 (LLNL employees and indirect)	250 (LLNL employees) 490 (LLNL employees and indirect)
Expenditures	Dollars (2001)	LLNL	142 M (Bay Area)	146 M (Bay Area)
Payroll	Dollars (2002)	LLNL	668 M (LLNL employees) 1,100 M (LLNL employees and indirect)	690 M (LLNL employees) 1,130 M (LLNL employees and indirect)

LLNL = Lawrence Livermore National Laboratory; M = million.

5.2.2.2 Impact Analysis

LLNL jobs and expenditures generate indirect jobs in the region. The Regional Input-Output Modeling System (RIMS) II economic model produces two multipliers that are useful for the evaluation of economic effects (BEA 2003). The first multiplier is used to calculate worker earnings and the second calculates employment. These multipliers provide information needed to estimate LLNL's economic impact. Earnings and employment multipliers make possible the identification of not only the direct impacts of an activity on regional income and jobs, but also the indirect effects.

To develop estimates of employment growth, employment projections for the No Action Alternative were based on staffing increases associated with new facilities and initiatives beyond the year 2004. Over the next 10 years, LLNL employment at the Livermore Site is projected to increase by 290 to reach approximately 8,900. Therefore, the No Action Alternative may create an additional 290 direct employment opportunities in Alameda County, generate additional

revenue from increased purchases of goods and services, and create increases in population and subsequent increases in housing demand. The employment projections are conservatively high for purposes of evaluating the maximum potential environmental impacts associated with the additional jobs at LLNL.

As of September 2002, approximately 240 personnel were employed by LLNL at Site 300. Over the next 10 years, Site 300 employment is projected to increase by fewer than 10 employees, therefore, socioeconomic impacts would be minimal.

Employment and Expenditures

Region

The No Action Alternative would provide additional employment opportunities in the region and would increase the payroll at LLNL. Assuming a 300-employee increase in payroll and pay rates proportional with 2002 salaries, the additional payroll generated under the No Action Alternative would be an annual increase of \$22 million (in 2002 dollars) by 2014. A portion of this increased payroll would enter the local economy as the new workers purchase additional goods and services. The effects of increased employment would result in a combined direct and indirect employment increase of approximately 600 jobs within the region. Likewise, the direct and indirect effect of payroll expenditures would result in a \$36 million increase to the regional economy.

In addition, it is anticipated that the No Action Alternative would result in an annual \$4 million increase in expenditures by LLNL within the nine-county Bay Area. Additional goods and services would be required to support the additional activities, facilities, and workers generated under the No Action Alternative.

The additional expenditures by new personnel and by LLNL would generate additional income and employment opportunities within the region as the expenditures filter throughout the economy. However, the additional income and employment opportunities generated under the No Action Alternative would have minimal economic impact within the region, given the large employment and economic basis in the ROI.

Alameda County

Total employment in Alameda County was estimated at 751,680 in 2000 (Association of Bay Area Governments 2001). The No Action Alternative is assumed to generate 290 additional jobs at the Livermore Site. Employment projections for Alameda County suggest that employment opportunities would increase 14.1 percent to reach 857,450 by 2010 (Association of Bay Area Governments 2001). The additional jobs created by the No Action Alternative at the Livermore Site would represent 0.3 percent of the projected increase in employment within the county. This minimal increase in employment, less than a 0.1 percent increase over the 2000 employment level, would have minimal economic impact within the county.

San Joaquin County

Total nonfarm employment in San Joaquin County was estimated at 191,700 in 2001 (EDD 2003). The nonfarm employment was used to eliminate seasonal agricultural employment spikes from the analysis. The No Action Alternative would generate a maximum of 10 additional jobs at Site 300. Employment projections for the county estimate that employment opportunities would increase 22.3 percent to 234,430 by 2010 (SJCOG 2000). The additional jobs created by the No Action Alternative at Site 300 would represent 0.02 percent of the projected increase in employment within the county. This minimal increase in employment, a 0.01 percent increase over the 2001 employment level, would have a negligible economic effect on the county.

Population and Housing

For this analysis, increases in population level and housing demand under the No Action Alternative are projected to be conservatively high in order to determine the maximum reasonably foreseeable impact. It was assumed that someone outside of the ROI would fill each new job, that all new LLNL workers (including LLNL employees, contractors, and Federal employees) would migrate to the region, and that each worker would represent a new household. In reality, a percentage of new workers would already reside in the project region, and some households would shelter more than one LLNL worker. While this method may overestimate potential migration of new workers to the project region, it also allows for the “backfilling” of vacancies left as some workers leave their current jobs in the region to work at LLNL. The geographic distribution of future LLNL worker residences is expected to be similar to the 2002 distribution of employee residences (Table 5.2.2.2–1).

Alameda County

Based on the anticipated geographic distribution of worker residences (Table 5.2.2.2–1), the No Action Alternative would result in a migration of 166 LLNL workers to Alameda County over 10 years. This represents 55.5 percent of the 300 new LLNL personnel. Assuming 2.74 persons per household for the county (Census 2003), the population associated with the additional workforce potentially migrating into the county would be 455 persons. This represents 0.03 percent of the 2000 population within the county. Population projections for the county estimate a 16.8 percent increase by 2010 (Association of Bay Area Governments 2001, Census 2003). The incremental population increase associated with the No Action Alternative would be within growth projections for the county.

Assuming one worker per household, housing demand generated by the additional workforce would be 166 dwelling units over 10 years, raising the total number of housing units occupied by LLNL workers to approximately 6,050 within Alameda County. In 2002, the county had 546,735 housing units. The vacancy rate in the county was 3.0 percent, an estimated 16,620 available units (DOF 2002). Demand for housing associated with the project’s additional personnel assumed to live in Alameda County would represent 1.0 percent of the 2002 vacant housing within the county. Impact to housing within the county is expected to be minimal.

City of Livermore

As seen in Table 5.2.2.2–1, the greatest percentage of new LLNL workers (37 percent, or 111 workers) would reside in Livermore, based on the 2002 pattern of employee residence location. Using the person per household figure of 2.81 for the city (Census 2002b), and assuming one worker per household, the population increase associated with the workforce migrating into the city would be 312 persons. This represents 0.4 percent of the city of Livermore's 2000 population. Growth projections for the city anticipate a 23 percent increase in the city's population by 2010 (Association of Bay Area Governments 2001).

TABLE 5.2.2.2–1.—Anticipated Geographic Distribution of Lawrence Livermore National Laboratory Worker Residences Under the No Action Alternative

City	Percent of LLNL Workers ^{a,b}	Number of New Workers Projected to Reside in City ^c
Alameda County		
Livermore	37.0	111
Pleasanton	6.2	19
Castro Valley	4.0	12
Dublin	2.1	6
Oakland	2.1	6
Other Alameda County	4.1	12
Total	55.5	166
San Joaquin County		
Tracy	8.2	25
Manteca	4.8	14
Stockton	2.6	8
Other San Joaquin County	2.9	9
Total	18.5	56
Contra Costa County		
Brentwood	2.7	8
San Ramon	2.7	8
Other Contra Costa County	7.4	22
Total	12.8	38
Stanislaus County		
Modesto	3.2	10
Other Stanislaus County	2.9	9
Total	6.1	19
Counties Outside the ROI		
Total	7.2	22

Source: LLNL 2003ak.

^a Distribution as of September 30, 2002.

^b May not total 100 because figures are rounded off.

^c Calculated based on 300-employee increase. May not total 300 because of rounding.

LLNL = Lawrence Livermore National Laboratory; ROI = Region of Influence.

Assuming each new worker migrating into the city creates a demand for one additional housing unit, a total of 111 units over 10 years would be required under the No Action Alternative. In 2000, the city had a housing supply of 26,610 units and a vacancy rate of 1.8 percent (Census 2002b). This represents 487 available housing units. The current city of Livermore Housing Implementation Program, covering the 3-year period from 2002 through 2004, limits housing unit growth to a maximum of 1.5 percent per year (City of Livermore 2001). As this plan is subject to renewal after 2004, the 1.5 percent housing unit growth rate represents the best available estimate for future growth. Assuming an annual growth rate of 1.5 percent, a total of 5,363 new housing units would be available by the year 2014. The demand for housing in the city associated with new employees would represent 2.1 percent of the projected number of new housing units. Because population growth as a result of the No Action Alternative could be accommodated in the current housing market and housing growth is projected to continue, minimal impacts are anticipated.

City of Pleasanton

Nineteen, or 6.2 percent, new workers employed under the No Action Alternative would reside in Pleasanton, based on the anticipated geographic distribution of personnel (Table 5.2.2.2–1). Using the person per household figure of 2.73 (Census 2002b), the city of Pleasanton population increase associated with new personnel would be 52 persons. This represents 0.1 percent of the 2000 population of 63,654. This increase would be within growth projections for the city, which project a 22 percent population increase by 2010 (Association of Bay Area Governments 2001).

Housing demand generated by new workers as a result of the No Action Alternative would be 19 housing units over 10 years, assuming one household per new employee. The 2000 housing supply within the city was 23,968 units, with a vacancy rate of 2.7 percent (Census 2002b). This represents an available supply of 657 units. The demand for housing units associated with new workers would represent 2.9 percent of the number of available vacant units in 2000. In addition, there is a projected 18 percent increase in the supply of housing by the year 2010 (Association of Bay Area Governments 2001). Because population growth as a result of the No Action Alternative could be accommodated in the current housing market and housing growth is projected to continue, minimal impacts are anticipated.

San Joaquin County

Based on the anticipated geographic distribution of personal residences of currently employed LLNL workers, 56 of the new workers would reside within San Joaquin County (Table 5.2.2.2–1). Based on the person per household figure of 3.17 in San Joaquin County (Census 2003), the population associated with the new employees would be 178 persons. This represents 0.03 percent of the total population within the county in 2001. County growth projections estimate that the population will rise to 727,800 by the year 2010, a 26.2 percent increase (DOF 2001, Census 2003). The incremental population increase associated with the No Action Alternative would be accommodated within county growth projections.

Housing demand generated by new workers, assuming one LLNL worker per household, in the county would total 56 units over 10 years, raising the total number of housing units occupied by LLNL workers to approximately 2,020 within San Joaquin County. The 2002 housing supply

within the county was 197,279 units, with a vacancy rate of 3.9 percent (DOF 2002). The total number of vacant units was 7,767. County projections estimate a 26 percent increase in the number of housing units within the county by the year 2010 (SJCOG 2000). Because the demand generated by the project would be minimal relative to the number of available and planned units, minimal impacts are anticipated.

City of Tracy

Based on the anticipated geographic distribution of new personnel, 25 new workers could move to the city of Tracy over the next 10 years. Based on the person per household figure of 3.23 for the city of Tracy (Census 2002a), the next population associated with the No Action Alternative would be 81 persons. This represents 0.1 percent of the 2000 population.

Additional housing demand arising from the No Action Alternative within the city of Tracy would be an additional 25 dwelling units. The housing supply within the city in the year 2000 was 18,087 units (Census 2002a). The vacancy rate for the city was 2.7 percent in 2000, which represents 467 available units. The demand generated by the new workers would represent 5 percent of the existing supply of available vacant housing. In addition, the number of housing units in the city is projected to increase 38 percent by the year 2010 (SJCOG 2000). The housing demand under the No Action Alternative could be accommodated in the current and projected housing supply, and minimal impacts are anticipated.

Environmental Justice

As indicated in Sections 5.2.1, 5.2.4, 5.2.5, 5.2.6, 5.2.7, 5.2.9, and 5.2.10, no discernible adverse impacts to land uses, prehistoric and historic cultural resources, aesthetics and scenic resources, geology and soils, biological resources, water, or noise are anticipated under the No Action Alternative. Thus, no disproportionately high and adverse impacts to minority or low-income communities are anticipated for these resource areas. Potential impacts to other resource areas are discussed below.

As indicated earlier in this section, under the No Action Alternative, 10,650 workers would be required at the Livermore Site and 250 workers would be required at Site 300. The number of housing units affected would be proportional to the changes in worker population. There is no indication that distribution of new workers would result in disproportionately high and adverse impacts to minority or low-income populations.

Within community services, as described in Section 5.2.3, the only notable impact would be to the generation and disposal of nonhazardous solid waste. For the No Action Alternative, it is estimated that 4,600 metric tons per year of solid waste would be generated at the Livermore Site for landfill disposal. At Site 300, nonhazardous solid waste generation would increase to 208 metric tons per year. Any impact to landfill capacity or lifespan would be area-wide, and not result in disproportionately high and adverse impacts to minority or low-income populations.

As presented in Section 5.2.8, the MEI for radiological air emissions at the Livermore Site would be located due east of the NIF, once the NIF becomes operational. The MEI dose under the No Action Alternative would be 0.098 millirem per year, and the population dose would be expected to be 1.8 person-rem per year. At Site 300, the MEI would be located west-southwest of Firing

Table 851. The MEI dose under the No Action Alternative would be 0.055 millirem per year, and the population dose would be 9.8 person-rem per year. Because areas immediately surrounding both LLNL sites have relatively low proportions of minority and low-income populations, there would be no disproportionately high and adverse impacts to these groups.

As presented in Section 5.2.11, traffic near the Livermore Site would increase slightly as a result of the increase in worker population by 290 workers under the No Action Alternative. At Site 300, the impact to traffic due to the addition of 10 workers would be negligible. Transportation of radioactive materials offsite would increase under the No Action Alternative. The collective radiation dose to the population along the transportation route is calculated at 5.0 person-rem per year, corresponding to 0.003 LCFs. No disproportionately high and adverse impacts to minority or low-income communities would be anticipated based on these estimates.

As presented in Section 5.2.12, the projected peak electrical demand at LLNL would be 82 megawatts and the annual total use would be 446 million kilowatt hours. In 2004, the State of California projects the statewide peak demand to be 53,464 megawatts and projects a growth in peak demand of about 2.4 percent per year. LLNL's projected peak demand in 2004 is therefore 0.1 percent of the total State demand. The State of California currently projects an adequate supply/demand balance through the year 2008, but has not made supply projections beyond that year. Any impacts related to LLNL's electricity use would be regional, and would not disproportionately affect minority or low-income populations.

As discussed in Section 5.2.13, waste generation for both routine and nonroutine wastes would be increased under the No Action Alternative. Levels of waste generation are within the capacities for treatment, transportation, or storage either onsite or at waste repositories. There would be no disproportionately high and adverse impacts to minority or low-income populations as a result of this waste generation.

As presented in Section 5.2.14, worker dose due to ionizing radiation would be 90 person-rem per year. The increase from current dose is mainly in new facilities coming online and increased activities in the Superblock. There would be no disproportionately high and adverse impacts to minority or low-income populations as a result of this increased dose.

Areas of soil and groundwater contamination exist at the Livermore Site and Site 300, as presented in Section 5.2.15. Although there is no immediate threat to human health from this contamination, there is localized degradation of groundwater. Appropriate cleanup measures are being implemented with the concurrence of regulators. There would be no disproportionately high and adverse impacts to minority or low-income populations as a result of these actions.

As discussed in Section 5.5, any of the bounding radiological accidents for LLNL would result in less than one LCF. Bounding accident scenarios for chemical, explosive, and biological accidents are unlikely to result in fatalities to the general public. None of these accidents would have disproportionately high and adverse impacts to minority or low-income populations.

Based on the analyses of all the resource areas, the course of operations would not pose disproportionately high and adverse health or environmental impacts on minority and low-income populations.

5.2.2.3 Cumulative Impacts

It is assumed that new workers associated with the No Action Alternative would reside in the communities in the same proportion as listed in Table 5.2.2.2–1. More than 220 new hires would reside in these 11 communities, ranging from 111 workers in the city of Livermore to 6 in the cities of Dublin and Oakland. In addition, an estimated 74 workers would be distributed throughout other communities in the Bay Area and central San Joaquin Valley. The No Action Alternative would therefore contribute to the cumulative demand for housing in the region associated with new employment opportunities created by planned and approved projects in the region. However, because vacancy rates are high enough to meet the demand of new employees within Livermore, with the highest concentration of LLNL employees, it is assumed that other parts of the region could meet the housing demand created by the increase in local job opportunities.

5.2.3 Community Services

This section analyzes the impacts to community services associated with implementation of the No Action Alternative. The section organizes the impact analysis by site and type of service.

5.2.3.1 Relationship with Site Operations

This section summarizes the relationship between projects described in Section 3.1 for the No Action Alternative and the community services impact analysis. In general, the effects of projects under the No Action Alternative on community services are related to additional employment opportunities and changes in floorspace. Employment under the No Action Alternative is detailed in Section 5.2.2. New construction projects, as listed in Section 3.1, would add to floorspace, but D&D projects, as part of an overall laboratory-wide consolidation, would decrease floorspace. Employment parameters are listed in Table 5.2.3.1–1.

TABLE 5.2.3.1–1.—Input Parameters for Community Services Analysis Under the No Action Alternative

Parameter	Units	Site	Existing Environment	No Action Alternative
Employment	Number of personnel	Livermore Site	10,360	10,650
		Site 300	240	250

5.2.3.2 *Impact Analysis*

Livermore Site

Fire Protection and Emergency Services

The No Action Alternative would not affect onsite fire protection and emergency services, or offsite fire protection agencies. The No Action Alternative would result in a 3 percent employment increase and incremental changes in floorspace. Therefore, demands for fire protection and emergency services because of the No Action Alternative would be similar to those under present conditions. The LLNL Fire Department currently provides adequate onsite service. The adequacy of these services would continue to be evaluated on an annual basis, and personnel, equipment, and facilities would be increased or upgraded as necessary.

LLNL interacts infrequently with offsite fire protection agencies. Interaction would remain similar to the current level under the No Action Alternative. Current fire protection and emergency service needs of LLNL do not affect offsite fire protection agencies' ability to provide service within their respective jurisdictions or mutual aid network. Thus, minimal impacts are anticipated.

Police Protection and Security Service

The 3 percent employment increase under the No Action Alternative would not affect onsite security services or offsite police protection agencies. Under the No Action Alternative, demands for security services would remain similar to those under present conditions. The LLNL Safeguards and Securities Department currently provides adequate onsite security protection.

LLNL interacts infrequently with offsite police protection agencies. Under the No Action Alternative, interaction is expected to remain similar to the current levels. Current security needs of LLNL do not affect the ability of offsite police protection agencies to provide service within their respective jurisdictions or emergency response network. Thus, minimal impacts are anticipated.

School Services

Employment at LLNL would increase by approximately 300 under the No Action Alternative; therefore, the number of students associated with this alternative would increase as well. The number of new students is estimated using the current percentage of Livermore residents enrolled in the Livermore Valley Joint Unified School District (19 percent), multiplied by the number of new Livermore residents that would be expected under the No Action Alternative, as discussed in Section 5.2.2. The additional 312 Livermore residents under the No Action Alternative would result in about 60 children expected to enroll in the Livermore Valley Joint Unified School District. Additional students generated from increased employment at LLNL would be expected in the school system incrementally over the next 10 years. Although several district schools are near capacity, there is currently adequate space district-wide (Miller 2003). The 60 student increase represents 0.4 percent of district enrollment. Based on an expected annual enrollment growth rate of 1.5 percent from Livermore's Housing Implementation Plan, the 60 student increase would be 2.2 percent of the total enrollment growth by the year 2014.

Because the district's facilities are adequate to meet current student demand, the addition of 60 students to the existing facilities would result in minimal impact on the district's ability to plan for and provide service within its jurisdiction.

As discussed in Section 5.2.2, the employment of 300 new workers at LLNL under the No Action Alternative would lead to an additional 300 indirect jobs within the ROI. Because of the relatively high proportion of new LLNL workers that would reside in the city of Livermore, some of those additional jobs would likely be created within the community. If the distribution of indirect worker residences were the same as for LLNL workers, 60 students could be added to the Livermore Valley Joint Unified School District in addition to the 60 students projected for LLNL workers, as described above. However, the actual number of students added through indirect jobs would be much less than 60, as many of the additional jobs and worker residences to support LLNL workers residing in Livermore would be created in neighboring communities and other areas throughout the ROI.

Nonhazardous Solid Waste Disposal Services

The No Action Alternative would not result in an adverse impact on the ability of Alameda County to provide solid waste disposal space. The amount of solid waste generated at the Livermore Site for landfill disposal under the No Action Alternative, based on employment increase, would be 4,600 metric tons, or approximately 3 percent more than recent levels. The Altamont Landfill is estimated to have sufficient capacity to receive waste until the year 2038 (Hurst 2003). The current total permitted throughput at the Altamont Landfill is 11,150 tons per day (SWIS 2002). The increase in solid waste under the No Action Alternative would represent less than 0.01 percent of permitted landfill throughput. Therefore, due to the remaining lifespan of this landfill, minimal impacts to solid waste disposal within the county are anticipated.

Site 300

Impacts discussed above for the Livermore Site for fire protection and emergency services, police protection and security services, school services, and nonhazardous solid waste disposal services are also applicable to Site 300. As employment at Site 300 is projected to increase by only 10 employees over current levels, anticipated impacts to community services are minimal.

5.2.3.3 Cumulative Impacts

Livermore Site

The 3 percent employment increase and incremental change in floorspace under the No Action Alternative would result in demands on fire protection and emergency services, as well as police protection and security services that are similar to the current level. LLNL fire protection and security staff currently provides adequate service onsite and current needs do not affect the ability of offsite agencies to provide service within their respective jurisdictions. Therefore, the No Action Alternative would not result in a cumulative impact on either onsite or offsite fire protection and emergency services or police protection and security services.

Employment at LLNL would increase by approximately 300 employees, 111 of which would reside in the city of Livermore. The projected 60 student increase in enrollment within the Livermore Valley Joint Unified School District would contribute to the cumulative demand for school services. As new school capacity would be required for the 2,700 additional students arising from non-LLNL-related increases to the expected population increases in the region projected during the next 10 years, the portion of the student increase attributable to the No Action Alternative (2 percent) would be within extra capacity design criteria.

Under the No Action Alternative, the rate of nonhazardous solid waste generated at the Livermore Site and Site 300 for disposal would be within 3 percent of present levels. Thus, this alternative would not contribute to additional cumulative demand for nonhazardous landfill capacity at the Altamont Landfill or impact operations at the Tracy Material Recovery and Solid Waste Transfer Station.

Site 300

Cumulative impacts discussed above for the Livermore Site for fire protection and emergency services, police protection and security services, and nonhazardous waste disposal services are also applicable to Site 300. However, there would only be an increase of 10 employees at Site 300, therefore there would be no measurable additional strain on the local school systems.

5.2.4 Prehistoric and Historic Cultural Resources

This section analyzes the impacts to cultural resources associated with implementation of the No Action Alternative. The impact analysis is organized by location and type of resource. Steps taken to reduce potential impacts are also discussed, as are the measures to be implemented to ensure compliance with the NHPA.

5.2.4.1 Relationship with Site Operations

This section summarizes the relationship between projects described in Section 3.2 under the No Action Alternative and the analysis of cultural resources. In general, those projects with the potential to impact these resources include construction of new facilities and infrastructure, as well as D&D, rehabilitation, and renovation of existing facilities.

5.2.4.2 Impact Analysis

Livermore Site

The probability of affecting prehistoric resources at the Livermore Site would be very low because: (1) field and archival research have not identified any prehistoric resources; (2) the geomorphic setting of the site makes it unlikely that any such resources exist; and (3) extensive modern horizontal and vertical development has disturbed much of the site. Although no impacts to prehistoric resources would be expected, unrecorded subsurface prehistoric resources still could be inadvertently discovered during construction or other ground-disturbing activities.

The inadvertent discovery of cultural material at the Livermore Site would be addressed as described above. No additional impacts to these resources are expected.

The No Action Alternative would have the potential to impact important historic buildings and structures on the Livermore Site through D&D, rehabilitation, and renovation of existing facilities. However, implementing the Programmatic Agreement (Appendix G) would avoid, reduce, or mitigate any impacts from these actions.

Site 300

Impacts to known prehistoric and historic resources at Site 300 would be unlikely to result from the No Action Alternative. NNSA recognizes the sensitivity of the resources and has established buffer zones to protect them. Implementation of the Programmatic Agreement (Appendix G) and continuation of current management practices would result in protection of these sensitive areas. Although no impacts to known resources would be expected, there is still the possibility that unrecorded subsurface prehistoric or historic resources could be inadvertently discovered during construction or other ground-disturbing activities.

The inadvertent discovery of cultural material at Site 300 would be addressed as described above for the Livermore Site. No additional impacts to these resources are expected.

The No Action Alternative would have the potential to affect important historic buildings and structures on Site 300 through D&D, rehabilitation, and renovation of existing facilities. However, implementing the Programmatic Agreement (Appendix G) would avoid, reduce, or mitigate any impacts from these actions. Therefore, no additional impacts are expected.

5.2.4.3 Cumulative Impacts

The Livermore Valley has undergone tremendous growth and development over the past decade. Because preservation measures such as Section 106 are only initiated when Federal agencies are involved, it is likely that the onset of development has caused the irretrievable loss of cultural resources in the region. Since cultural resources exist at both the Livermore Site and Site 300, future program activities could result in resource loss and add to regional attrition of these resources. Any potential impacts to cultural resources at LLNL would be mitigated through implementation of the Programmatic Agreement (Appendix G), thereby reducing LLNL's contribution to resource attrition.

5.2.5 Aesthetics and Scenic Resources

This section analyzes the potential impacts of the No Action Alternative on aesthetics and scenic resources. The existing aesthetics and scenic resources are discussed in detail in Chapter 4, Section 4.6, of this LLNL SW/SPEIS.

5.2.5.1 Relationship with Site Operations

This section summarizes the relationship between the projects described in Section 3.2 under the No Action Alternative and the analysis of aesthetics and scenic resources. In general, effects to aesthetics and scenic resources would be limited to construction of buildings and infrastructure located in areas visible to public viewing.

5.2.5.2 *Impact Analysis*

Livermore Site

Activities under the No Action Alternative would include improvements to existing buildings and infrastructure, D&D of existing buildings, and construction of new facilities. Development and modifications would largely occur within the developed portion of the site, would be similar in character to surrounding uses, and would be largely screened from public view by the surrounding fencing and trees. Based on previous LLNL landscaping and development practices, it is anticipated that development of these projects at the Livermore Site under this alternative would be largely consistent with the existing character of the site.

Views of the Livermore Site resemble a campus-like or business park-like setting, including buildings, internal roadways, pathways, and open space. Although construction or modifications under the No Action Alternative may alter these views to some degree, these changes would have no impact on the visual character of the site.

Only two projects would be built in areas open to public viewing and would become a part of existing view sheds. These include the International Security Research Facility/Sensitive Compartmented Information Facility near the southwest side of the site near Vasco Road, and the East Avenue Security Upgrade and construction of new entrance gates at each end of the road. The new facilities would be visible from the adjacent residential areas and Vasco Road, which is a designated scenic route by the route element of the Alameda County General Plan (Alameda County 1994). Construction activities for the new facilities and supporting infrastructure would cause a short-term adverse impact on the views from these roads. Similar to other proposed interior development, the new facilities would be similar in size and character to existing structures at the Livermore Site and would be landscaped to be compatible with the surrounding campus-like setting. Therefore, although the facilities would be more visible from the immediate surrounding area, they would not alter the site's overall appearance or character.

The Livermore Site is also visible in the middle ground and background view sheds from the surrounding residential and rural areas and designated scenic routes. Viewers from these areas would not notice a change in the built environment within the site. While viewers in these areas might perceive a slight increase in the built space at the facility because of the two projects described above, the development would occur within a context of similar development and would be indefinite as a result of the viewing distance. Also, the view of the site would often be obscured by intervening topography, vegetation, and structures. The site would remain compatible with local and county scenic resource plans and policies.

Consequently, the changes to the built environment as a result of the No Action Alternative would have no long-term impacts on the visual character of the Livermore Site, views of the site from public viewing areas, or existing view sheds of the surrounding environment. No additional impacts are expected to visual resources.

Site 300

Activities under the No Action Alternative would include improvements to existing buildings and infrastructure. Development and modifications would largely occur within the developed

portion of the site in the General Services Area (GSA) and would be similar in character to surrounding uses. Based on previous LLNL landscaping and development practices, it is anticipated that the development of these projects at Site 300 under this alternative would be largely consistent with the existing character of the site. One project would occur outside the developed portion of Site 300. The Wetlands Enhancement Project would be located in low-lying areas not visible to the public. This project would involve modification of wetland areas to be more conducive to California red-legged frog habitat, with no change to the view shed for workers at Site 300. Consequently, there would be no negative impacts to the visual character of the site.

Views of Site 300 resemble a campus-like or business park-like setting in the GSA, and natural undeveloped areas everywhere else. Although construction or modifications under the No Action Alternative might alter these views to some degree, these changes would have no impacts on the visual character of the site.

Site 300 is visible from Tesla Road, Corral Hollow Road, and the Carnegie State Vehicular Recreation Area. Tesla Road is designated as a scenic route by the scenic route element of the Alameda County General Plan (Alameda County 1994). When approaching Site 300 from the west on Tesla Road, views of the site consist of rolling hillsides. No structures or landscaping on Site 300 are presently visible from this roadway, and no construction or upgrade activities are proposed in the southwest corner of the site.

In general, views of Site 300 from Corral Hollow Road are limited due to distance and intervening topography and consist primarily of buildings and infrastructure in the GSA. Changes proposed at Site 300 would either occur in the interior of Site 300, which is not visible from the surrounding area; would have minor effects on aesthetics such as modification of existing facilities or utility upgrades; or would occur in the GSA where such changes would be consistent with the existing visual character of the site. Construction and facility improvement activities in the GSA would be visible from Corral Hollow Road and would have short-term visual impacts. However, these activities would be obscured by intervening topography, fencing, vegetation, or structures, and would be temporary.

Views of Site 300 from the Carnegie State Vehicular Recreation Area consist primarily of undeveloped hillsides. Due to the large size of the site, the few construction and maintenance activities planned for the interior of the site would not be visible from the recreation area and would not change the middle ground and background views of the site. Overall, Site 300 would remain compatible with local and county scenic resource plans and policies.

Consequently, no impacts of Site 300 would occur to the built environment as a result of the No Action Alternative, to views of the site from public viewing areas, or to existing view sheds of the surrounding environment.

5.2.5.3 *Cumulative Impacts*

There are no planned projects in the vicinity of the Livermore Site and Site 300 that, in combination with LLNL activities, would have an adverse impact on existing view sheds or the

surrounding environment. Under the No Action Alternative, there would be no cumulative impacts to aesthetics and scenic resources in the region.

5.2.6 Geology and Soils

This section analyzes the impacts to geology and soils associated with the implementation of projects described in Section 3.2 under the No Action Alternative. The impact analysis is organized by geologic resources, topography and geomorphology, and geologic hazards.

5.2.6.1 Relationship with Site Operations

Under the No Action Alternative, there are future facilities at the Livermore Site that would generally be located in the undeveloped areas (Figure 5.2.6.1–1) and are assessed for potential soils disturbance impacts. These facilities are listed in Table 5.2.1.2–1. In general, any future development in the developed area at the Livermore Site would generally involve areas where soils have already been disturbed and therefore would not involve any impacts to soils.

At Site 300, one future project would be included under the No Action Alternative with potential for disturbing undeveloped soils. Under the Site 300 Wetlands Enhancement Project, artificial wetlands near Buildings 801, 827, 851, and 865 totaling approximately 0.62 acres created by surface water runoff would be terminated. These wetlands would be replaced by enhancing wetland habitat in other locations. Approximately 1.09 acres would be disturbed as part of this project.

5.2.6.2 Impact Analysis

Geologic Resources

Livermore Site

No known aggregate, clay, coal, or mineral resources would be adversely affected by the No Action Alternative. None of the activities under the No Action Alternative would take place near or upon any known or exploitable mineral resources, unique geologic outcrops, or other unique geologic features. No impacts to farming or grazing are expected.

Under the No Action Alternative, several facilities would be built in the undeveloped areas at the Livermore Site. Table 5.2.1.2–1 presents these facilities along with the estimated amount of land that would be disturbed by their construction. A total of 462,000 square feet would be disturbed as a result of construction under the No Action Alternative.

As discussed in Section 4.8, fossils were discovered in the peripheral parts of the excavation for the NIF. The fossil localities were found 20 to 30 feet below the present surface. Under the No Action Alternative, the potential would exist for the inadvertent excavation of fossils within this depth range during construction. Should any buried materials be encountered, LLNL would evaluate the materials and proceed with recovery in accordance with the requirements of the *Antiquities Act*.

Site 300

No known aggregate, clay, coal, or mineral resources would be adversely affected by the No Action Alternative. None of the activities that would proceed under the No Action Alternative are near or on any known or exploitable mineral resources, unique geologic outcrops, or other unique geologic features. None of the activities would affect farming or grazing. Under the No Action Alternative, the Site 300 Wetlands Enhancement Project and the connection to the Hetch Hetchy Aqueduct would be completed at Site 300. The termination of water flow to the 0.62 acres of wetlands would result in the drying of the soils at the associated locations, but no disturbance would occur. Enhancement of wetland habitat at Mid Elk Ravine and the seep at the former Super High Altitude Research Project (SHARP) Facility would involve the disturbance of 1.09 acres of soils. There would be no impacts to any known or exploitable mineral resources or unique geologic features.

Several vertebrate fossil deposits have been found on Site 300 and in the vicinity of Corral Hollow. The fossil finds are generally widely scattered, and no significant invertebrate or botanical fossil localities have been identified on Site 300 or in the surrounding area (Hansen 1991). Under the No Action Alternative, there are no projects involving the disturbance of those areas, therefore, there would be no impacts to any known fossil deposits. Should any buried fossil materials be encountered during any construction, LLNL would evaluate the materials and proceed with recovery in accordance with the requirements of the *Antiquities Act*.

Topography and Geomorphology**Livermore Site**

The No Action Alternative would not include project work that would impact the topography or geomorphology of the Livermore Site, and no construction or excavation projects are planned that would alter these features of the landscape. As only the best management practices would be employed to minimize erosion associated with ongoing operations, no additional impacts are expected.

Site 300

The No Action Alternative would not include project work that would impact the topography or geomorphology of Site 300. No construction or excavation projects are planned that would alter these features of the landscape. As only the best management practices would be employed to minimize erosion associated with ongoing operations. No additional impacts are expected.

Geologic Hazards

The geologic hazards associated with the Livermore region are part of the character of that region. The hazards exist regardless of the presence of human activities, buildings, or facilities. Therefore, there is no difference in the geologic hazards among the alternatives. Potentially strong earthquakes ground motion sources at Livermore Site and Site 300 are discussed briefly below. Detailed discussion is presented in Section 4.8 and Appendix H and includes the major regional fault zones as well as local faults.

The information on geologic hazards is part of the input to the design, engineering, and operation of the LLNL facilities. The risks from geologic hazards are associated with the potential for releases from these facilities of hazardous or radioactive materials due to spills, fires, or explosions resulting from earthquakes or landslides. The discussion of the facilities and the risks from geologic hazards are presented in Section 5.5, Appendix A, and Appendix D.

Livermore Site

The local faults in the Livermore Valley region are the main seismic hazard to the Livermore Site. The Livermore Site Seismic Safety Program recently performed a new assessment of the geologic hazards at the Livermore Site. Although new data and methodologies were used, the most recent study reports essentially the same results as previous studies for the prediction of the peak ground acceleration. Appendix H, Seismicity, presents the results of these seismic hazard analyses and the evaluation of structures. Maximum horizontal peak ground accelerations at the Livermore Site for return periods of 500, 1,000, and 5,000 years are 0.38 g, 0.65 g, and 0.73 g, respectively. The unit g is equal to the acceleration due to the gravity of the Earth or 9.8 meters/second/second (32 feet/second/second). The technical basis for these peak ground accelerations values is provided in Appendix H. These peak ground accelerations are evaluated along with other factors to determine the level of ground motion facilities would experience during earthquakes.

A large earthquake on the Greenville Fault is projected to produce the maximum ground-shaking intensities in the Livermore area with a Modified Mercalli (MM) intensity ranging from strong (MM VII) to very violent (MM X). The MM IX level is associated with damage to buried pipelines and partial collapse of poorly built structures (City of Livermore and LSA 2002). Design and location requirements for new facilities, including waste management facilities, must take into account distance from active faults and the ground shaking to be expected within certain probabilities. The level of active seismicity results in the classification of the area as Seismic Risk Zone 4, the highest risk zone in the California Building Code (City of Livermore and LSA 2002). Adverse impacts to proposed structures, related infrastructure, and surrounding communities could occur from hazardous materials release and/or structural failure of buildings and facilities following a major seismic event.

Site 300

A seismic hazard analysis of Site 300 produced peak acceleration estimates of 0.32 g, 0.38 g, and 0.56 g for return periods of 500, 1,000, and 5,000 years, respectively, for the Building 854 Complex near the western boundary of the site, and 0.28 g, 0.34 g, and 0.51 g for the Building 834-836 Complex near the eastern boundary (TERA Corp. 1983). A recent seismic hazard analysis of the Livermore Site (see Appendix H) and surrounding area described the Corral Hollow-Carnegie Fault zone as potentially active and calculated its contribution to seismic risk as just below that for the Calaveras Fault and greater than any other faults in the region. The Elk Ravine Fault was not considered active in that analysis.

There is a potential for surface faulting at Site 300. Buildings 899A and 899B at the pistol range could experience ground deformation during a major earthquake occur on the Carnegie Fault. However, these two structures contain no hazardous or radiological materials and have very low

occupancies. A greater number of facilities are located near the Elk Ravine Fault, however, that fault is not considered active.

Additionally, potential exists for seismically induced landslides at Site 300 due to the presence of landslide deposits and relatively steep slopes. The potential for slope instability is greater on northeast-facing slopes underlain by the Cierbo Formation. Buildings 825, M825, 826, M51, 847, 851A, 851B, 854, 855, and 856 are located on old landslides deposits. The potential for ground deformation at these buildings is considered to be moderate to high.

A landslide could result in spills, fire, explosions, or burial of facilities within its path. The hazards and impacts of spills, fire, and explosions, regardless of cause are discussed in Section 5.5 and Appendices A and D. The impacts of burial of materials due to a landslide would be similar to spills and the firing of explosives at these facilities. These facilities have material limits under which they work on batches of materials. The working limits for explosives are close to the amounts detonated at the firing sites. The spread of materials into the environment when the explosives are detonated would be similar to the amount of materials that would be buried in a landslide.

5.2.6.3 Cumulative Impacts

Sandia National Laboratories/California (SNL/CA) projects approximately 100 acres of soil disturbance in connection with their activities and future facilities. A large portion of the disturbance would occur within areas that are already developed. The soils in the vicinity of the LLNL are capable of supporting agriculture. While there is a large amount of undeveloped land in Alameda County, continuing development in the immediate vicinity of the LLNL would contribute to the cumulative loss of agricultural land. The projects associated with the No Action Alternative would not contribute to the overall loss of agricultural land because the LLNL has been committed to R&D/industrial use instead of agriculture for decades.

5.2.7 Biological Resources

This section analyzes the potential impacts of the No Action Alternative on biological resources, including vegetation, wildlife, protected and sensitive species, and wetlands. The current operations and existing biological resources are discussed in detail in Appendices E and F and summarized in Chapter 4, Section 4.9, of this LLNL SW/SPEIS.

5.2.7.1 Relationship with Site Operations

This section summarizes the relationship between projects described in Section 3.1 for the No Action Alternative and the ecological impact analysis. In general, the effect of No Action Alternative projects on biological resources would occur primarily in areas that have been previously disturbed at the Livermore Site and Site 300 by construction, maintenance, wildfire prevention, and security activities.

5.2.7.2 *Impact Analysis*

Vegetation

Livermore Site

Under the No Action Alternative at the Livermore Site, approximately 462,000 square feet (10.6 acres) of land disturbance would occur, consisting mainly of building construction, facility upgrades, and operational modifications (Section 5.2.6.3). This equates to approximately 1.6 percent of undeveloped land for new construction. The following projects would be constructed in undeveloped areas: the East Avenue Closure, the Extension of Fifth Street, the International Security Research Facility, and a general office building as noted in Table 5.2.1.2–1. Some of the new facilities that would be constructed in the previously developed areas of the Livermore Site include the BioSafety Level-3 (BSL-3) Facility and Edward Teller Education Center. A complete list of projects is provided in Appendix A, Section A.1.5.

The No Action Alternative would affect vegetation principally by clearing land for construction projects. Activities include building construction, upgrading existing buildings, road and parking lot repairs, modification of site energy management, and other activities. Projects under the No Action Alternative would occur on land that currently does not support vegetation, that has been landscaped, or that supports an early successional plant community indicating the presence of recent land disturbance. Therefore, the impacts of the No Action Alternative on vegetation would be minimal.

Site 300

The No Action Alternative would affect vegetation at Site 300 principally by clearing land for infrastructure modernization (e.g., new or upgraded facilities; grading and maintaining fire trails; storm drainage system maintenance; culvert maintenance and replacement; termination of surface water releases at several facilities). New facility construction would support the Site 300 Revitalization Project, the Wetland Enhancement Project, and Response Training Center. Under the Site 300 Revitalization Project, vegetation would not likely be disturbed since only distribution of water from the Hetch Hetchy Aqueduct infrastructure that has already been built remains under this project. Components of the Response Training Center that might impact biological resources have already been completed. These activities would occur primarily on previously disturbed land occupying less than 350 acres. Areas where buildings and related infrastructure are present do not support vegetation, have been landscaped, or support an early successional plant community indicative of recent land disturbances. Approximately 1.86 acres of disturbance of vegetation would also occur during construction of the Wetland Enhancement Project, which is further discussed in Section 5.2.7.3 and Appendix E, Section E.2.2. The impact of the No Action Alternative on Site 300 vegetation would be minimal.

Prescribed burning would continue to be conducted annually as a means of wildfire control on approximately 2,000 acres. Burning typically would begin at the end of May and last several weeks, though this schedule depends on the length of the growing season and amount of rainfall (LLNL 2003q). Native grassland communities on Site 300 occur almost exclusively in areas with annual prescribed burning (Appendix E, Figure E.1.1.3–1), and researchers have previously

noted that frequent fire is required to establish and maintain grasslands dominated by native grasses in lowland California (Barry 1972, BioSystems 1986a, Heady 1972). These annual prescribed burns may have an additional beneficial impact by reducing the presence of certain invasive plants, such as yellow starthistle (Lass et al. 1999, Pollak and Kan 1998).

Tritium Levels in Vegetation and Commodities

LLNL has historically released tritium to the air during routine operations and, occasionally, by accident. Tritium is the only radionuclide released from LLNL activities that occurs in detectable concentrations in vegetation and foodstuffs. In 2001, tritium was measured quarterly in vegetation at 18 fixed locations in the Livermore Valley, San Joaquin County, and Site 300. This monitoring was performed in support of an NNSA commitment to determine if there is a measurable buildup of radionuclides in the environment (LLNL 2002w).

LLNL tritium impacts on vegetation in the Livermore Valley remained minimal in 2001. In the Livermore Valley, the maximum potential dose from ingested tritium is based on the conservative assumptions that an adult's diet consists exclusively of leafy vegetables with the measured tritium concentrations, as well as meat and milk from livestock fed on grasses with the same concentrations. Nevertheless, based on these extremely conservative assumptions, the maximum potential dose from ingestion of vegetables, milk, and meat for 2001 for the Livermore Valley is 0.0069 millirem per year (LLNL 2002w).

With the exception of vegetation from previously identified sites of contamination, the tritium levels at Site 300 were below the limits of detection and comparable to those observed in previous years. The areas where tritium is known to be present in the subsurface soil are well delineated and localized. The calculated maximum potential annual ingestion dose from vegetation, based on the maximum value of 73,000 picocuries per liter, is 1.3 millirem. This dose, based on the conservative modeling assumptions described above, is theoretical, but nevertheless small, because vegetation at Site 300 is not allowed to be harvested for consumption by people or used as feed for livestock (LLNL 2002w).

In 2001, 12 bottles of wine produced in the Livermore Valley, 6 bottles of California wines from outside the Livermore Valley, and 4 bottles of wine from European vineyards were analyzed for tritium. All the wine tritium concentrations were far below drinking water limits. The highest tritium concentration in Livermore Valley wine (70 picocuries per liter) represents only 0.35 percent of the California drinking water standard (20,000 picocuries per liter). Based on the conservative assumption that wine is consumed at the same rate as the average consumption of water (370 liters per year or about 1 liter per day), the annual dose that corresponds to the highest detected 2001 Livermore Valley tritium concentration in wine is 1.7×10^{-3} millirems. For a hypothetical individual consuming 1 liter per week using the median tritium values from the three sampling areas, the annual doses from Livermore, Europe, and California wines would be 1.3×10^{-4} millirem, 1.1×10^{-4} millirem, and 3.7×10^{-5} millirem, respectively (LLNL 2002w).

The LLNL contribution to tritium exposure levels in the Livermore Valley has trended downward by approximately one order of magnitude as evidenced by the decline in the dose to the site-wide MEI at the Livermore Site between 1990 and 2001 (Appendix B, Table B.4.10.1–2). A similar trend was noted for tritium released in air during the same period

(Table 4.10.5–1). In general, the median tritium concentrations in plant water for vegetation at the Livermore Site and Site 300 show a similar downward trend between 1988 and 2001, when one sampling location at the Livermore Site and two sampling locations at Site 300 were excluded where tritium contamination has been identified (LLNL 2002w).

Under the No Action Alternative, it is anticipated that tritium impacts on vegetation and wine might increase slightly as Tritium Facility activities at the Livermore Site would increase. Tritium emissions would increase from approximately 30 curies in 2002 to 210 curies per year for the foreseeable future. In addition, Site 300 and NIF would begin to use tritium. However, any increase in tritium impacts on vegetation and wine may be difficult to detect due to the historically low levels currently being recorded and operational safeguards that are in place.

Wildlife

Livermore Site

The No Action Alternative would result in the clearing of 552,000 square feet of vegetation with a commensurate loss of wildlife habitat at the Livermore Site for proposed projects on land that has been previously disturbed. Any impacts to animals would be minimal and some displaced animals may be able to occupy adjacent habitat.

Site 300

The No Action Alternative would result in minimal clearing of vegetation with little loss of wildlife habitat at Site 300 for the Site 300 Revitalization Project, the Wetland Enhancement Project, and the Response Training Center. Both the Site 300 Revitalization Project and Response Training Center have been completed relative to components that might impact biological resources. Some loss of less mobile animals, such as reptiles and small mammals, could occur during construction of the Wetland Enhancement Project. Any impacts to the animal populations would be very small and some displaced animals would be able to occupy adjacent habitat.

Protected and Sensitive Species

This section discusses species listed as endangered, threatened, or proposed under the Federal *Endangered Species Act* and *California Endangered Species Act* affected by the No Action Alternative as well as unaffected species with similar status or indicated as species of concern. Additionally, species protected by the *Migratory Bird Treaty Act* and certain rare plants listed by the California Native Plant Society found at Site 300 are also discussed. The discussion for Site 300 is more detailed than that for the Livermore Site, which has been more disturbed. The species discussed include those for which information exists. Mitigation measures for listed species discussed below may be modified as a result of subsequent consultation with the USFWS and California Department of Fish and Game (CDFG).

Livermore Site

Under the No Action Alternative, LLNL would continue to fulfill its obligation to maintain Arroyo Las Positas (previously modified to handle a 100-year flood event) and onsite tributaries

for flood capacity. The focus of the Arroyo Las Positas Maintenance Project is to allow the function and needs of onsite drainage capacity of the arroyo to be met in a timely and consistent manner without overlooking the preservation and habitat conservation requirements pertaining to the federally threatened California red-legged frog (LLNL 1998a, USFWS 1997, DOE 2002j, USFWS 2002e). For further details of the Arroyo Maintenance Project and ongoing consultation with the USFWS for this project, see Appendix E, Section E.2.1.

No California red-legged frogs have been identified in 1,800 feet of Arroyo Seco within the Livermore Site boundaries from the Vasco Road bridge to the East Avenue culvert (LLNL 2003ab). However, this segment of Arroyo Seco could be used by populations of that species in the vicinity of the site. A separate Biological Assessment has been prepared to assess the impacts of the proposed Arroyo Seco Management Plan and was submitted to the USFWS in August 2003.

Formerly designated critical habitat for the California red-legged frog at the Livermore Site proposed for reinstatement by the USFWS is shown in Chapter 4, Figure 4.9.3–1. Construction of new structures proposed under the No Action Alternative (e.g., BSL-3 Facility and the Edward Teller Education Center) at the Livermore Site would not be in proposed designated critical habitat for the California red-legged frog or areas where this species typically occurs. Other operations would not be anticipated to result in the loss of proposed designated critical habitat for this species.

In 1997, bullfrogs were noted in the southern sediment basin, a sediment trap south of the Drainage Retention Basin. A bullfrog management program, coordinated with the USFWS, was initiated to minimize the adverse impact of this invasive species, which is a predator of the California red-legged frog (DOE 2002j, USFWS 2002e). See Appendix E for further discussion.

Measures to protect the California red-legged frog during Arroyo Las Positas Maintenance Plan high-bank mowing and pruning activities would continue. These previously approved USFWS measures (LLNL 1998a, USFWS 1998) include:

- The site wildlife biologist would survey project sites for California red-legged frogs prior to work being initiated.
- Areas identified as having California red-legged frogs would be marked with LLNL special-status species flags, tape, or other visible demarcations. A map would be disseminated to the project crew with the sensitive frog location exclusion zones clearly outlined.
- All vegetation cutting and removal in these areas would be performed in a manner that would not directly impact frogs.
- Vegetation cutting within 50 feet of the frog pool in Reach 1 and the two pools in Reach 2 would be performed using rotary tools and to a height of at least 24 inches. All vegetation cutting within this area would be performed by a qualified wildlife biologist.

Measures to protect the California red-legged frog during Arroyo Las Positas Maintenance Plan dredging activities in the Arroyo Las Positas and elsewhere would continue. These previously approved USFWS measures (LLNL 1998a, USFWS 1998) include:

- The site wildlife biologist would survey project sites for California red-legged frogs prior to work being initiated.
- Areas identified as having California red-legged frogs would be marked with LLNL special-status species flags, tape, or other visible demarcations.
- Prior to the project impact activity, these areas would be searched and any frogs found would be collected (by a USFWS-approved biologist) and placed in a ponded enclosure until the annual maintenance procedures of dredging, etc., have been completed; then they would be returned to the arroyo at or near the location where they were collected.
- Prior to new construction or security buffer maintenance activities, construction sites would be surveyed by the site wildlife biologist for California red-legged frogs prior to work being initiated.

In addition to the California red-legged frog management activities discussed above, there are various measures taken at the Livermore Site to protect birds covered by the *Migratory Bird Treaty Act*. The white-tailed kite, a California species of special concern, is known to nest at the Livermore Site. Therefore, construction activities are avoided to the extent practical near active white-tailed kite nests until young are fledged. All trees identified for removal are inspected for active bird nests in order to comply with the *Migratory Bird Treaty Act*.

Site 300

Affected Species

The No Action Alternative would affect three federally listed species (California red-legged frog, California tiger salamander, and Alameda whipsnake) proposed reinstated critical habitat for the California red-legged frog, and rescinded critical habitat for the Alameda whipsnake. The first affected species is the California red-legged frog, a federally listed threatened species. Formerly designated critical habitat for the California red-legged frog and its breeding and nonbreeding locations at Site 300 are shown in Figure 4.9.3–3. Proposed termination of surface water releases for an artificial wetland at Building 865 would affect this species, because it has been a known breeding location for 6 years. However, the elimination of these wetlands that were the result of past cooling tower discharges and are now maintained through irrigation with potable water that would return this part of Site 300 closer to its ecological state prior to the discharges and irrigation. Termination of water to a small, artificially maintained wetland at Building 801 would eliminate a potential breeding site for this frog species, although no California red-legged frogs occur at this site. Elimination of very small wetlands associated with the cooling towers at Buildings 851 and 827 would eliminate two low quality habitat locations for the California red-legged frog where frogs have not been observed for the past 6 years. Appendix E, Section E.2.2.6, provides further details on potential impacts of this project and mitigation measures taken to minimize those impacts. Proposed termination of surface releases at Buildings 865, 851, and 827 was coordinated with USFWS. Approval was received contingent upon implementation of mitigation measures in a recent Biological Assessment and related biological opinion (Jones and Stokes 2001, USFWS 2002b). This proposed termination could start as early as 2004 (LLNL 2003ab).

Grading of fire trails disturbs sediment that could directly affect California red-legged frog habitat suitability. However, the use of best management practices could reduce adverse effects to this species by minimizing erosion of fire trails into drainages as discussed in Appendix E, Section E.2.2.6 (Jones and Stokes 2001). Two such practices may include the use of native grasses to reseed disturbed areas that are prone to erosion, and selective installation of erosion control fabrics in areas where applicable.

LLNL is proposing to mitigate the 0.62-acre artificial wetlands at Buildings 801, 865, 851, and 827, removed by continued operations at Site 300 under the No Action Alternative, by enhancing selected areas and increasing breeding opportunities for the California red-legged frog. These designated areas would be managed and protected for the California red-legged frog and California tiger salamander. A minimum of 1.86 acres of wetland habitat would be enhanced and managed for the California red-legged frog and California tiger salamander. Potential mitigation sites for enhancement include the wetlands at the seep at the SHARP Facility and the Mid Elk Ravine. This mitigation measure has been previously addressed in a recent Biological Assessment and related Biological Opinion (Jones and Stokes 2001, USFWS 2002b) (see Appendix E, Section E.2.2.9, for more information).

The second affected species is the California tiger salamander, a federally listed proposed threatened species (68 FR 28649). Chapter 4, Figure 4.9.3–4, shows wetland locations where this species has been observed at Site 300. Grading of fire trails typically occurs mid through late spring. Mortality to individuals is unlikely to occur. Although proposed storm drainage and culvert improvement activities could result in direct mortality of California tiger salamanders, proposed mitigations for the California red-legged frog contained in a recent biological assessment and related biological opinion would greatly minimize the potential for such adverse impacts (Jones and Stokes 2001, USFWS 2002b). Appendix E, Section E.2.2.6, provides further details on mitigation measures taken to minimize impacts of the No Action Alternative on this species.

The third affected species is the Alameda whipsnake, a federally listed threatened species. Figure 4.9.3–5 shows formerly designated critical habitat and potential habitat for the Alameda whipsnake at Site 300. Grading of fire trails as well as prescribed burns in grasslands adjacent to Alameda whipsnake habitat in sage scrub and rock outcrops have the potential to affect this species. However, a biological assessment and related biological opinion address mitigations that would minimize the potential for adverse effects from these proposed activities (Jones and Stokes 2001, USFWS 2002b). Fire trail maintenance and prescribed burns are annual activities that would continue during the 10-year period covered by this LLNL SW/SPEIS. Section E.2.2.6 provides further details on measures taken to minimize impacts of the No Action Alternative on this species.

Unaffected Species

Activities under the No Action Alternative would not affect the following federally listed endangered, threatened, and candidate species: the large-flowered fiddleneck, the San Joaquin kit fox, and the valley elderberry longhorn beetle. The large-flowered fiddleneck is federally listed as endangered and state listed as endangered (CDFG 2002b). Additionally, a portion of Site 300 has been designated as critical habitat for the large-flowered fiddleneck (Figure 4.9.3–2). Activities included in the No Action Alternative would not affect the large-flowered fiddleneck population at Site 300. The large-flowered fiddleneck population near the Drop Tower would

continue to receive protection by maintaining the fence, controlling access, and prohibiting activities that could adversely affect the population.

LLNL has an ongoing monitoring program for the large-flowered fiddleneck at Site 300. This monitoring program would be continued. Additionally, research is being conducted on the natural and experimental populations of the large-flowered fiddleneck to develop techniques to control the cover of exotic annual grasses while developing techniques to restore native perennial grasslands and preserve (or increase) population levels of this plant. The research activities also monitor the status of three other rare plants at Site 300:

- The big tarplant that is extremely rare throughout its range.
- The diamond-petaled poppy, which was presumed extinct and rediscovered in 1993.
- The gypsum-loving larkspur, which is on the California Native Plant Society watch list indicating it is a rare, but with a wide enough distribution so as not to be threatened at this time (LLNL 2002dj).

The 2002-2003 rare plant monitoring program replaced the gypsum-loving larkspur with the round-leaved filaree. Included in this monitoring program is research to determine to what extent burn frequency affects the spread of one-sided bluegrass (LLNL 2002dj). Section E.2.2 provides further details on why these species would not be affected under the No Action Alternative.

The San Joaquin kit fox is federally listed as endangered and state listed as threatened. Protocol level surveys were conducted for this species in 1991, and hundreds of project-specific surveys have been conducted at the site since 1993. No kit fox were recorded at Site 300 in 1991 nor have they been observed there in subsequent surveys, including one in 2002 (Jones and Stokes 2001, CSUS 2003). However, kit fox were observed in nearby properties in the 1990's (Sproul and Flett 1993). A comprehensive mitigation and monitoring plan was developed for this species (LLNL 1992a).

Elderberry bushes are habitat for the federally listed valley elderberry longhorn beetle. The valley elderberry longhorn beetle is federally listed as threatened. In May 1997, USFWS issued Site 300 a biological opinion for pruning elderberry shrubs along the edge of a fire trail in the southeast corner of the site for three separate time periods. One pruning occurred in May/June 1997, and no beetles or evidence of beetles were detected (Jones and Stokes 2001). However, during surveys in 2002, 10 exit holes considered to be from valley elderberry longhorn beetles were found in elderberry plants. Additionally, six adult beetles were observed in a canyon just north of Elk Ravine, with two of the adults clearly exhibiting identifying characteristics of the valley elderberry longhorn beetle (Arnold 2002). No facility construction activities would be allowed to occur within a 300-foot radius of known locations of elderberry bushes without prior consultation with the USFWS. Because of these protective measures, valley elderberry longhorn beetle would not be adversely affected.

The California linderiella fairy shrimp, a Federal species of concern, occurs at Site 300. During a 2001-2002 wet season survey, this branchiopod species was found in a vernal pool (FS-04) in the northwest part of Site 300 (Condor Country Consulting 2002). However, because proposed

projects under the No Action Alternative would not affect this seasonal pool, the California linderiella fairy shrimp would not be adversely affected.

The willow flycatcher, a California-listed endangered species was observed for the first time at Site 300 during a constant effort mist netting survey in Elk Ravine in 2003 (LLNL 2003ac). The willow flycatcher would not likely be adversely affected since it was observed in a part of Elk Ravine not affected by continuing operations at Site 300.

Many migratory bird species have been observed at Site 300 (see Table 4.9.1–1). Construction activities would be coordinated with LLNL wildlife biologists to ensure that nests are protected as applicable to the *Migratory Bird Treaty Act*.

The following existing practices would be continued to benefit multiple species:

- The employee awareness program on biological mitigation measures would continue for LLNL employees and contract personnel working at Site 300 in areas where special status species are present.
- The use of rodenticides and other rodent control measures at Site 300 would be minimized to the extent practicable.
- Vehicle traffic would also be confined to existing roads (paved and unpaved) to the extent possible.
- To maintain and promote habitat diversity, the livestock grazing exclusion and annual controlled burning program on Site 300 would continue.
- Fire roads and disked areas would be maintained in the same locations to the extent possible. After evaluation, where possible, duplicate roads paralleling other roads would be eliminated.
- Herbicide use would remain limited to areas around buildings and other facilities, or eliminated, to the extent practicable.
- Consistent with current construction practices, all food-related trash items such as wrappers, cans, bottles, and food scraps would be disposed of in a closed container or removed from the construction site.
- The monitoring program for the San Joaquin kit fox described in the 1992 LLNL EIS/EIR would be continued (LLNL 1992a).
- Sites designated for new construction would be surveyed for the presence of various species or their nests or dens that are protected under Federal and State of California laws, with avoidance or other mitigative measures implemented as deemed appropriate.

Wetlands

Livermore Site

Proposed new construction of buildings under the No Action Alternative would occur in upland areas, so that land clearing would not be anticipated to have direct or indirect impacts on wetlands. New construction projects would include best management practices to avoid runoff that could affect wetlands. Wetlands along Arroyo Las Positas would be impacted if discharged treated water from the environmental restoration program is terminated; such termination is being considered under the No Action Alternative (LLNL 2001ap). Future actions involving these wetlands may require coordination with the U.S. Army Corps of Engineers (USACE), such as ongoing efforts to develop a water management plan for an 1,800-foot segment of Arroyo Seco within Livermore Site boundaries from the Vasco Road bridge to the East Avenue culvert (LLNL 2001ap). Additionally, the State of California has a no net loss policy regarding wetlands, including artificial wetlands (CERES 2002).

Site 300

There are 8.61 acres of wetlands at Site 300 of which 4.39 acres were found to meet criteria for jurisdictional wetlands subject to USACE regulation under Section 404 of the *Clean Water Act* (Jones and Stokes 2002c). Other than the Wetland Enhancement Project, new construction under the No Action Alternative would have minimal direct or indirect impacts on wetlands.

Under the No Action Alternative, artificial wetlands (totaling 0.62 acres) that have been created by surface water runoff near Buildings 801, 827, 851, and 865, would be terminated. A Section 404 permit would be required from the USACE for dredge and fill permit and a Section 401 certification or waiver will need to be obtained from the Regional Water Quality Control Board. Proposed mitigation measures for this action involve the protection and enhancement of a minimum of 1.86 acres of wetland habitat (Jones and Stokes 2001, USFWS 2002b).

5.2.7.3 Cumulative Impacts

Under the No Action Alternative, approximately 552,000 square feet (12.7 acres) of terrestrial habitat at the Livermore Site would be disturbed due to proposed construction activities. No terrestrial habitat would be eliminated at Site 300. SNL/CA is managing its section of the Arroyo Seco to enhance California red-legged frog habitat and developing a 30-acre wildlife preserve on the east side of the facility. The incremental effect of the No Action Alternative on biological resources within the area would be positive, particularly in the long term, when taken in the context of continuing conversion of wildlife habitat for agricultural, residential, and commercial and industrial use in the Livermore Valley and near Site 300.

5.2.8 Air Quality

5.2.8.1 Nonradiological Air Quality

Relationship with Site Operations

The No Action Alternative will involve some changes at both the Livermore Site and Site 300, but for the most part, it is a continuation of current activities. Facility upgrades, D&D activities, and new facility construction are normal during any 10-year period. Therefore, potential air quality impacts of planned activities associated with the No Action Alternative should be considered in relation to current activity levels, as a means to assess and compare planned actions and bound impacts to the air resources. The general parameters that will be used in the analyses of potential air quality impacts are listed in Table 5.2.8.1–1.

TABLE 5.2.8.1–1.—Summary of Input Parameters for Air Quality Analysis Under the No Action Alternative

Parameter	Units	Site	Existing Environment	No Action Alternative
Daily Vehicle Traffic	1,000 vehicles	Livermore	22.0	22.6
		Site 300	0.5	No change
Air emission sources and facility status	-	Livermore	The Livermore Site is rated as a mid-sized facility, subject to offset requirements for nonattainment pollutants POC and NO _x . The site's controls on POC and NO _x sources are rated good by the BAAQMD. The Livermore Site is not rated as a major source for HAPs under NESHAP.	No change
		Site 300	Site 300 is a small source per definition of the SJVUAPCD and also a nonmajor source for HAPs under NESHAP.	No change

BAAQMD = Bay Area Air Quality Management District; NESHAP = National Emission Standards for Hazardous Air Pollutants; HAP = hazardous air pollutant; NO_x = oxides of nitrogen; POC = precursor organic compounds; SJVUAPCD = San Joaquin Valley Air Pollution Control District.

Impact Analysis

Modifications to Facilities or Operations

As described in Section 3.2, the No Action Alternative encompasses not only the continuation of many LLNL activities, but also planned facility and infrastructure improvements and the completion of construction and operation of recently approved facilities with existing NEPA documentation.

Facility and infrastructure renovations (e.g., replacement of ductwork and roofs, installation of seismic and physical security upgrades, and repairs and modifications to roads) and new facility construction are normal during any 10-year period. The projected level for these activities under the No Action Alternative would remain on par with current levels, and LLNL would continue to include standard measures for controlling pollution as part of every design and construction project. With the mitigation measures in place, impacts will be similar to current levels.

Standard mitigation measures related to construction activities include the following:

- Fugitive emissions must be controlled in accordance with stringent air district requirements (discussed in Section 5.1.8.1), which include measures such as water spraying of disturbed areas and covering exposed piles of excavated material.
- LLNL contractors must complete a project-specific task identification process list and project-specific safety plan for all projects. The task identification process lists typical construction hazards and concerns and is used by subcontractors to help identify potential topics to be addressed in their project-specific safety plans.
- LLNL requires the use of late model, cleaner burning internal combustion diesel engines (Tier I or Tier II) for construction.

The LLNL Environmental Protection Department, Hazards Control Department and Plant Engineering staff review all design and provide guidance on construction projects, review the task identification process list prior to commencing construction, and routinely inspect construction work sites to ensure adherence to project-specific requirements.

The No Action Alternative would include the construction and operation of planned and approved facilities. These include administrative and staff offices, a conference center, and training facilities. Together, these would increase the developed area by about 1.5 percent. Space utilization would not differ appreciably from current allocations. In fact, many of the activities to be housed within new structures are ongoing activities that would be relocated and/or consolidated. Activity relocations would be reviewed for compliance with air permit requirements in relation to their new settings. Where activities would require new air permits or modifications to existing air permits, these would be secured prior to construction or operation.

The planned activities at the Livermore Site would result in some additional fuel use. Natural gas is used in boilers, and diesel fuel is used in generators. Both are tested periodically. Several criteria and toxic air contaminants are emitted from fuel combustion. Oxides of nitrogen are a concern locally as a contributor to ozone formation. The increased fuel use anticipated under the No Action Alternative would result in an incremental increase in oxides of nitrogen emissions, 0.32 tons annually, which would be less than 2 percent of the oxides of nitrogen emissions from this source category under current operating conditions.

Because fuel combustion sources are recognized as potentially significant sources of criteria pollutant emissions, LLNL has enacted standard measures to mitigate emissions from this source category (LLNL 2001s). These include the following:

- Fuels must meet the requirements of the *Clean Air Act Power Plant and Industrial Fuels Use Act*, and applicable DOE orders, and would continue to require that construction equipment and vehicles be inspected daily for leaks of fuel, engine coolant, and hydraulic fluid.
- Contract specifications for boilers require adherence to the American Society of Heating, Refrigerating and Air Conditioning Engineering, Inc., for energy efficiency, and compliance

with efficiency standards is tested in accordance with American Society of Mechanical Engineers methods.

Decommissioning, Decontamination and Demolition

The No Action Alternative would include the planned removal of 234,443 gross square feet of excess and legacy facilities at the Livermore Site and 20,202 gross square feet at Site 300, as part of a campaign to reduce the amount of active nonassignable space and optimize the use of existing space. This rate would be similar to that of recent years, and LLNL would continue to employ standard measures to control pollution from D&D activities, and comply with air district requirements to limit fugitive dust emissions. Air emissions and air quality impacts would be similar to existing conditions.

A major concern with demolition of older structures is the disturbance of asbestos containing materials (ACM). For those projects that may involve the disturbance of ACM, LLNL would continue to require that subcontractors be appropriately certified and employ engineering controls, devices, and work practices to isolate the source of asbestos and prevent fiber migration. These include the use of physical barriers (e.g., plastic sheeting) to separate asbestos work areas, keeping the asbestos work area at a negative pressure relative to adjacent areas, and using exhaust fans and vacuum cleaners with high-efficiency particulate air (HEPA) filters for asbestos control and cleanup. Specific requirements related to asbestos removals are detailed in the *Environment, Safety & Health (ES&H) Manual* (LLNL 2001t). LLNL also requires that the air district be notified of pending asbestos-related renovation and maintenance work, and planned asbestos-related demolition work above thresholds.

Support Personnel and Vehicular Activity

Planned activities associated with the No Action Alternative involve a projected increase in workforce, adding approximately 290 LLNL and other site workers at the Livermore Site by 2014 and possibly 10 workers at Site 300, with corresponding increases in vehicular activity, primarily workers commuting to and from the sites.

Impacts of workforce commute on air quality would be lessened through transportation demand management. A large employment center holds more opportunities for alternatives to the single-employee commute. LLNL has a transportation systems management program that provides and promotes alternative, environmentally responsible options for employee commuting, assists LLNL in complying with transportation-related CAA legislation, and resolves congestion-management issues. LLNL is committed to continuing this program that provides (LLNL 2001s):

- A pre-tax benefit program for transit and vanpool commuters, which enables employees to set aside a fixed amount of their pre-tax salary each month to reduce transportation costs
- Participation in the BAAQMD's and San Joaquin Valley Unified Air Pollution Control District's (SJVUAPCD's) "Spare the Air" programs

- Active participation in meetings with transportation planners from Livermore, Dublin, Pleasanton, other large employers, local school districts, and community outreach programs to mitigate transportation-related air pollution and congestion-management issues
- Participation in DOE's Clean Cities Coalition to increase availability and use of alternative-fueled vehicles for LLNL employees

The additional workforce would include some relocated employees, new to the Bay Area air basin. Activities of the relocated population would contribute to air emissions associated with the commute to the workplace and secondarily from the additional energy consumption, other vehicular use, and goods and services that would be required to support the additional, relocated population. The jobs that would be created under the No Action Alternative at LLNL would represent a very small fraction (less than 1 percent) of the projected increase in employment within Alameda County over the 2000 to 2010 timeframe as described in Section 5.1.2 (Association of Bay Area Governments 2001). The air quality impact of this population growth would be on the same order as that of the growth rate, and this would be well within the projections developed by the Association of Bay Area Governments, Metropolitan Transportation Commission, and BAAQMD, and employed in the clean air plan.

Cumulative Impacts

The parameters used to evaluate air quality impacts of the No Action Alternative are listed in Table 5.2.8.1–1. Table 5.2.8.1–2 presents the calculated maximum carbon monoxide concentrations, which would remain within 20 to 30 percent of ambient standards. Projected air pollutant emission rates associated with increased fuel combustion in boilers and engines, and the increased vehicular activity associated with increased workforce under the No Action Alternative are provided in Table 5.2.8.1–3.

Total emissions are also provided in Table 5.2.8.1–3 for comparison with significance levels. As discussed in Section 5.1.8, annual and daily significant emission levels are established by local air districts in response to local air quality concerns. A project that generates criteria air pollutant emissions in excess of significance levels would be considered to have a significant air quality impact and stringent mitigation would be required. LLNL has mitigation measures such as dust control measures and use of newer, cleaner (Tier I or Tier II) engines for construction. By evaluating project emissions as a whole, including motor vehicle emissions, this affords the air district a greater level of control over a project, i.e., it is not limited to source permitting.

The No Action Alternative would result in increased electrical use, which cumulatively contributes to greater demand and some additional air pollution. LLNL and DOE commitments to energy conservation, load management, and increased use of renewable energy sources (discussed in Appendix O, Section O.4.3) would help to offset this impact.

Total emissions associated with the No Action Alternative would be a small fraction of significance levels. Consequently, activities associated with the No Action Alternative would not result in an adverse impact to air resources.

TABLE 5.2.8.1–2.—Projected Maximum Carbon Monoxide Concentrations Associated with Increased Traffic Conditions in the Environs of the Livermore Site Under the No Action Alternative

	Existing Environment	No Action Alternative
Traffic Assessment ^a		
Peak hourly background traffic through intersection	3,757	3,757
Additional traffic related to alternative	-	62
Total traffic through intersection	3,757	3,819
Maximum One-Hour Concentrations (ppm)		
Near-roadway CO concentration ^b from:		
Background traffic	1.1	0.66
Increased traffic from alternative	-	0.012
Estimated background concentration ^c	3.9	3.5
Total - traffic plus background	5.0	4.2
% of state ambient air quality standard ^d	25	21
Maximum Eight-Hour Concentrations (ppm)		
Near-roadway CO concentration from:		
Background traffic ^c	0.75	0.46
Increased traffic from alternative ^c	-	0.008
Estimated background concentration	2.0	1.7
Total - traffic plus background	2.7	2.2
% of state ambient air quality standard ^d	30	25

^a Peak hourly traffic is estimated to be 10 percent of the total daily traffic passing through the intersection of Vasco and Patterson Pass Roads. This value (10 percent) is recommended by the air district for use when hourly values are not available. Local traffic patterns are discussed in Section 4.13.2.

^b Concentrations are assessed for locations 25 feet from roadway for the year 2004 (existing environment) and year 2014 (No Action Alternative). Assessment methodology is discussed in Section 5.1.8.1, and follows BAAQMD CEQA Guidelines (1999). Emission factors and ambient concentrations of carbon monoxide are expected to decline over time through 2010 due to improved emission controls on newer vehicles and reformulated gasoline.

^c Background carbon monoxide is defined as that part of the ambient CO concentration that is not attributable to traffic sources from a nearby street or intersection. It is calculated according to procedures recommended by BAAQMD (1999).

^d National one-hour ambient air quality standard is 35 ppm; more restrictive state standards, 20 ppm, is used. National and state eight-hour ambient air quality standard is 9 ppm.

BAAQMD = Bay Area Air Quality Management District; CEQA = *California Environmental Quality Act*; CO = carbon monoxide; ppm = parts per million.

Conformity

Livermore Site

Conformity analysis begins with the applicability review, which requires Federal agencies to identify, analyze, and quantify emission impacts of an action. It is required for any action that is Federally funded, licensed, permitted, or approved where the total direct and indirect emissions for criteria pollutants in a Non-attainment or Maintenance area exceed rates specified in 40 CFR §51.853.

Also, an action is subject to the General Conformity Rule if the emissions are deemed to be regionally significant, even if the total direct and indirect emissions are less than the specified rates (*de minimis* emissions) for any criteria pollutant in a Non-attainment or Maintenance area. LLNL air emissions are not regionally significant, Livermore Site emissions are less than 0.1 percent of Bay Area emissions, and Site 300 emissions are much less than 0.1 percent of San Joaquin Valley emissions (LLNL 2003). Therefore, it can be concluded that LLNL emissions are not regionally significant.

If a Federal action takes place in a Non-attainment or Maintenance area and meets any of the following two criteria, then the action may be classified as exempt:

- The total direct and indirect emissions for criteria pollutants are less than the specified threshold rates, shown below.
- Emissions will not increase, or an increase in emissions is clearly de minimis.

Bay Area air quality is classified as "Attainment-Maintenance" for carbon monoxide (CO), and non-attainment for ozone. The threshold for oxides of nitrogen (NO_x), precursor volatile organic compounds (VOCs) and CO is 100 tons per year. Bay Area is "Unclassified" for PM₁₀, which is not a "Non-attainment" classification. To be conservative, BAAQMD treats the "Unclassified" status of PM₁₀ as though it is "Non-Attainment-Moderate," when addressing conformity issues. If LLNL makes the same conservative treatment of the PM₁₀ status, then the threshold for PM₁₀ is 100 tons per year. Thus, the applicable thresholds for BAAQMD are NO_x (100 tons), VOCs (100 tons), CO (100 tons) and PM₁₀ (100 tons).

LLNL Livermore Site Construction and demolition projects under the No Action Alternative are described in Table A.2.3–1, Livermore Site Program Projections. New construction consists of the 1,500 square foot BioSafety Level-3 (BSL-3) Facility, the 54,000 square foot Container Security Testing facility, 20,000 square feet per year office removal and replacement project, the 1 acre Westgate Drive improvement project, and D&D Projects totaling 234,443 square feet. Westgate Drive improvement project consists of soil disturbance and paving, and not building construction.

Air emissions from the proposed facilities would result from initial construction activities, and from ongoing operations including R&D activities in the facility and building heating. The largest source of emissions would be from construction activities, including particulate emissions and combustion-related emissions from stationary engines and vehicles.

Emissions from R&D activities in proposed facilities are insignificant, typically on the order of a few pounds per day. For the purpose of this analysis, it is assumed that each of two new No Action Alternative buildings emits 2 pounds per day of VOCs for 200 days generating 0.4 tons per year. A 2 million British thermal unit (BTU) per hour boiler, used to heat each new facility, which is fired on average at a rate of 1 million BTU per hour, would use a total of 2,400 million BTU per year for the two buildings. Emission factors were obtained from AP-42, using emission factors developed by EPA for small natural gas fired boilers equipped with low-NO_x burners.

The D&D projects represent work over at least 10 years, therefore, it is estimated that the worst-case year of D&D would be 150,000 square feet for the No Action Alternative. It is assumed that office removal and replacement project would occur continuously at a rate of 20,000 square feet per year. It is also assumed that the new buildings will be at least two stories, so that the building square footage is approximately equal to the square footage of disturbed land. In summary, the No Action Alternative construction rate totals for Livermore Site would be 150,000 square feet for D&D, 75,500 square feet for new building construction and 1 acre for Westgate Drive soil disturbance.

The California Air Resources Board (CARB) emission factors for particulate matter from construction activity do not use the Federal AP-42 emission factors for construction activity, because the Federal values does not include the effect of applying water for dust control, which is a requirement in California. CARB uses an emission factor of 0.11 tons PM₁₀ per acre-month (CARB 2004). It is assumed that most of the new building construction will occur in a single year, a very conservative assumption. Therefore, for the No Action Alternative, the construction total would be 225,500 square feet (or 5.18 acres).

The construction activity will require the use of some tools and equipment powered by internal combustion engines, typically diesel engines. For the No Action Alternative, it is conservatively estimated that the equivalent of two engines, each at 250 horsepower would be used for these construction projects. The criteria pollutant emissions are estimated using AP-42, emission factors for uncontrolled gasoline and diesel industrial engines. Construction related internal combustion engine emissions from the two engines totaling 968,000 horsepower-hours are estimated from AP-42 emission factors.

For the No Action Alternative, it is estimated that the construction projects will result in an increase of 5 heavy vehicle trips per day, at 40 miles per trip, for eleven months resulting in 66,000 total miles. Emission factors for delivery trucks are found on the South Coast Air Quality Management District (SCAQMD) web site (SCAQMD 2004). The emission factors used were the highest (most conservative) 2002 emission factors for on-road vehicles (for delivery trucks).

Planned activities associated with the No Action Alternative involve a projected increase in workforce at the Livermore Site, adding approximately 290 LLNL and other site workers, with corresponding increases in vehicular activity, primarily workers commuting to and from the site, but also visitors, construction workers, delivery vehicles, waste haulers, and others. The projected number of additional trips was estimated on the basis of traffic counts derived from a 2002 study of all vehicles entering and exiting the gates at the Livermore Site (discussed in Section 4.13.4). This count (22,000 vehicles) was compared to the site workforce (LLNL and other site workers) for the corresponding timeframe to derive a population-weighted vehicle trip escalation factor (2.08). From this, it is estimated that at peak operation and staffing, there will be an additional 602 trips (one-way) daily. Each one-way trip averages slightly more than 7 miles, the average trip length projected for Alameda County for year 2014 (BAAQMD 1999).

Estimated total increased air emissions for the Livermore Site under the No Action Alternative are presented in Table 5.2.8.1–4. The 2002 emissions shown on the table are for permitted sources, and do not include emissions from motor vehicles or construction activities.

TABLE 5.2.8.1–4.—Increased Emissions for the Livermore Site Under the No Action Alternative (tons per year) For an Assumed Worst-Case Year

Emission Source	NO _x	CO	SO _x	PM ₁₀	VOC
Construction Engines ^a	9.5	1.4	0.99	0.44	0.57
Construction Vehicles ^a	0.089	0.56	0.001	0.003	0.064
Construction Dust ^a	-	-	-	6.5	-
Boiler Space Heating	0.06	0.1	-	0.009	0.43
Research Laboratories	-	-	-	-	0.4
Personal and Transport Vehicles	1.0	5.8	0.04	0.58	0.31
TOTALS	11	7.9	1.0	7.5	1.8
Conformity Threshold	100	100	-	100 ^b	100
2002 Livermore Site Emissions from Permitted Equipment	24	6.2	1	2.2	5.8

^a Category includes renovations, infrastructure improvements and demolition activities.

^b PM₁₀ is unclassified with respect to the NAAQS. The listed conformity threshold is provided for comparative purposes, but does not strictly apply.

Site 300

Site 300 construction and demolition projects under the No Action Alternative are described in Table A.3.3–1, Site 300 Program Projections. These projects include the 20,000 square feet per year Remove and Replace Offices, 20,202 square feet Deactivation and D&D Projects, and 2.48 acres for the Wetlands Enhancement project.

Air emissions from proposed facilities (EMPC and HEDC) would result from initial construction activities and ongoing operations including R&D activities in the facility and building heating. The largest source of emissions is from construction activity, including particulate emissions and combustion-related emissions from stationary engines and vehicles. Emissions were estimated, using similar methods as described above for Livermore Site.

SJVAPCD previously petitioned to be “Non-Attainment Extreme” with respect to the 1-hour ozone standard, and the petition was accepted by EPA. Therefore the applicable thresholds for both NO_x and VOC will be 10 tons per year. SJVAPCD is “Non-Attainment-Serious” for PM₁₀, therefore the applicable threshold for PM₁₀ is 70 tons per year. SJVAPCD is “Attainment-Maintenance” for CO, therefore the applicable threshold for CO is 100 tons per year. Thus, the applicable thresholds for SJVAPCD are NO_x (10 tons), VOC (10 tons), CO (100 tons) and PM₁₀ (70 tons).

Estimated total increased air emissions for Site 300 under the No Action Alternative are presented in Table 5.2.8.1–5. The 2002 emissions shown on the table are for permitted sources, and do not include emissions from motor vehicles or construction vehicles.

The emissions calculations above demonstrate that the emissions resulting from No Action Alternative activities are below the Federal conformity thresholds. This is true even in SJVAPCD, which has become an “extreme” non-attainment area, with respect to ozone. This analysis provides a separate and additional demonstration that the proposed LLNL projects are in conformity with CAA requirements and are exempt from further analysis.

TABLE 5.2.8.1–5.—Increased Emissions for Site 300 Under the No Action Alternative (tons per year) For an Assumed Worst-Case Year

Emission Source	NO _x	CO	SO _x	PM ₁₀	VOC
Construction Engines ^a	2.4	0.35	0.25	0.11	0.14
Construction Vehicles ^a	0.045	0.28	0.0004	0.0016	0.032
Construction Dust ^a	-	-	-	1.7	-
Personal and Transport Vehicles	0.036	0.20	0.001	0.020	0.011
TOTALS	2.5	0.83	0.25	1.8	0.19
Conformity Threshold ^b	10	100 ^b	-	70	10
2002 Site 300 Emissions from Permitted Equipment	0.40	0.37	0.026	0.033	0.084

^a Category includes renovations, infrastructure improvements and demolition activities.

^b Conformity thresholds in the San Joaquin air basin are lower (i.e., more stringent) than those in the Bay Area air basin, owing to the severity of the nonattainment classifications. These classifications are discussed in the text.

^c To be conservative, a conformity threshold is provided for CO, which is classified as “Attainment-Unclassified.”

5.2.8.2 Radiological Air Quality

This section analyzes the No Action Alternative radiological air quality impacts due to normal releases from ongoing site operations such as R&D and waste management. Impacts in terms of dose related to the Livermore Site and Site 300 are discussed in this section. Health impacts are discussed in Section 5.2.14.2.

Relationship With Site Operations

This section summarizes the relationship between projects described in Section 3.2 for the No Action Alternative and radiological air quality. As noted previously, the dose that would result from exposure to routine air emissions from these projects is used to quantify the impacts. The important incremental impact to the baseline emissions for the No Action Alternative would be due to the addition of NIF operations and increased releases from Building 331.

Impact Analysis

Livermore Site

Annual tritium releases from the Building 331 Tritium Facility would increase to a level of 210 curies per year, still well within historical levels (see Chapter 4, Figure 4.10.5–1). Up to 30 curies of tritium per year could be released during NIF maintenance activities, when equipment is opened up or its contents exposed to air (LLNL 2003d). Activated gases created by NIF experiments with fusion yield, nitrogen-13 (67.8 curies) and argon-41 (26.2 curies), would be released from NIF and would be short-lived nuclides that would affect the site-wide MEI externally by way of air immersion.

The location of the site-wide MEI would change from existing environment due to NIF releases. The NIF MEI dose (as a result of airborne effluents from that facility only) would be about 0.041 millirem per year, at a location due east of the NIF stack, along the eastern site boundary. Conservatively adding the existing environment dose and the increase in Tritium Facility dose at

the Credit Union to the NIF airborne effluent dose at this location would result in a No Action Alternative dose estimated at 0.098 millirem per year, 1 percent of the NESHAP limit.

The component of population dose from routine NIF releases would be 0.27 person-rem per year. Adding this dose to the Livermore population dose and the population dose due to the Tritium Facility releases would result in a No Action Alternative dose of 1.8 person-rem per year. The dose to the worker population was estimated by compositing the worker dose from the important contributing sources to the site-wide MEI dose, i.e., NIF and Tritium Facility, and the largest other sources of tritium, i.e., Building 612 Yard and outside Building 331. The No Action Alternative worker population dose would be 0.14 person-rem per year. Section 5.2.14 describes the relationship between these doses and health effects.

Minimal impacts on radiological air quality are expected from the No Action Alternative at the Livermore Site.

Site 300

The important incremental impact to the existing environment emissions under the No Action Alternative is from 20 milligrams per year (194 curies) of tritium released during explosives experiments. Such experiments have historically been performed at Site 300, although none were performed during 2001 (LLNL 2003i). The baseline year of 2001 for Site 300 normal release was chosen because the site-wide MEI dose from that year's operations were greater than those of 2002. Firing Tables B812 and B850 will not be used for tritium experiments. Firing Table B851 is the only open-air facility that would use tritium. The site-wide MEI location is 1,530 yards west-southwest of Firing Table B851. This location corresponds with the closest site boundary to any individual firing table.

Explosives experiments result in the releases being dispersed as a gaseous cloud (SNL 2002). Although the annual release quantity limits are known, the sizes of each of the experiments to be performed over the period covered by this LLNL SW/SPEIS are not. A single set of cloud parameters, e.g., cloud height, was thus defined that simulates the baseline results. The meteorology during each of these experiments is also unknown a priori. The CAP88-PC program, which models the release as continuous, is useful because it considers all possible meteorological conditions. This method is considered conservative. The resulting annual exposure calculated in the model corresponds to the mean exposure from the possible meteorological conditions. The CAP88-PC computer program was used to calculate the incremental No Action Alternative release of tritium. The dose to the site-wide MEI, which is the sum of the 2001 and incremental release dose, is 0.055 millirem per year, less than 0.6 percent of the NESHAP limit. The resulting population dose of 9.8 person-rem per year. The dose to the worker population would be 0.005 person-rem per year.

Minimal impacts on radiological air quality are expected under the No Action Alternative at Site 300.

Cumulative Impacts

No adverse impacts on radiological air quality are expected under the No Action Alternative. Other than background radiation sources, there are no other known contributors to concentrations

of radionuclides in air within 50 miles of the Livermore Site or Site 300. Therefore, there are no cumulative radiological air quality impacts.

5.2.9 Water

This section analyzes impacts to water resources associated with implementation of the No Action Alternative.

5.2.9.1 Relationship with Site Operations

This section summarizes the relationship between projects described in Section 3.2 under the No Action Alternative and the water impact analysis. The No Action Alternative would cause increases in water use, impervious surfaces and runoff, and use of materials that are potential contaminants due to construction and operation of projects.

5.2.9.2 Impact Analysis

Livermore Site

Surface Water

The addition of new buildings and roads under the No Action Alternative would increase impervious surfaces at the Livermore Site. An increase in surface runoff would occur as a result of increased impervious surface areas. However, because Livermore Site soils are highly permeable and abundant uncovered acreage remains for groundwater recharge, the impact of the reduction in recharge surface area under the No Action Alternative would be minimal.

Surface water resources could be degraded by contaminant releases during construction of some facilities under the No Action Alternative. Contaminant sources could include construction materials; hydraulic fluid, oil, and diesel fuel; and releases from transportation or waste-handling accidents. LLNL stormwater pollution prevention plans have been devised to identify pollutant sources that could affect the quality of industrial stormwater discharges and to describe implementation practices to reduce pollutants in these discharges. In the event of a hazardous spill, necessary equipment to implement cleanup is available, and personnel are trained in proper response, containment, and cleanup of spills. Further guidance on response to hazardous material spills is provided in the ES&H Manual.

In 2002, the Livermore Site used approximately 1.2 million gallons of water per day from the San Francisco Hetch Hetchy Aqueduct system and the Alameda County Flood and Water Conservation District, Zone 7 (LLNL 2003cj). Under the No Action Alternative, water use is expected to be 1.37 million gallons per day. This increase would be due to the water requirements of the NIF and Terascale Simulation Facility. Buildings and activities in addition to the NIF and Terascale Simulation Facility projected under the No Action Alternative would have a minimal effect on water consumption.

Compliance with an approved erosion and sedimentation control plan during construction would prevent impacts to surface water from construction-induced erosion.

Surface water monitoring would continue under the No Action Alternative in accordance with DOE guidelines to ensure remediation of contamination already present and detection of any hazardous materials in the future. Stormwater monitoring would continue in accordance with NPDES requirements. Wastewater monitoring would continue as discussed in Section 4.14.4. Because of the extensive monitoring program and capability to divert potentially contaminated wastewater, no impacts to the Livermore Water Reclamation Plant (LWRP) or downstream receiving surface waters would be expected.

Because no activities projected under the No Action Alternative would occur within the 100-year floodplain, other than Arroyo Las Positas Maintenance Project, which is covered under an environmental assessment (DOE/EA-1272) (DOE 1998b), no impacts to the floodplain would be expected. None of the No Action Alternative projects would contribute significant amounts of surface water runoff to cause substantial flooding because the 100-year base flood event is contained within all channels. Due to the high infiltration rates and lack of appreciable floodplains on the Livermore Site, hydrologic impacts under the No Action Alternative would be minimal. No facilities would be located in either the 100-year or 500-year floodplain, therefore no impact from flooding would be expected. Impacts to surface water would be minimal.

Groundwater

Currently, the following contaminants exist above drinking water standards in groundwater at the Livermore Site: trichloroethylene, perchloroethylene, 1,1-dichloroethylene, chloroform, 1,2-dichloroethylene, 1,1-dichloroethane, 1,2-dichloroethane, trichlorotrifluoroethane (Freon 113), trichlorofluoromethane (Freon 11), and carbon tetrachloride. LLNL removes contaminants from groundwater and unsaturated zones (soil vapor) at the Livermore Site through a system of 27 treatment facilities located throughout the 6 hydrostratigraphic units containing contaminants of concern. In 2002, almost 248 million gallons of groundwater were removed and treated, yielding approximately 146 kilograms of volatile organic compounds (VOCs). Remediation activities have been successful in containing the VOC plume at the southwest corner of the site. This area is of concern because the plume has migrated offsite, toward a residential area. Groundwater monitoring would continue under the No Action Alternative to ensure that remediation of contamination already present continues to be effective and that contaminant fate and transport is fully understood. Groundwater quality should continue to improve because extracted groundwater would be collected and treated at the treatment facilities.

Groundwater resources could be degraded by contaminant releases during construction of some facilities under the No Action Alternative. Contaminant sources could include construction materials; spills of hydraulic fluid, oil, and diesel fuel; and releases from transportation or waste-handling accidents. The potential for spills of hazardous materials to impact groundwater largely depends on the depth to groundwater where the spill occurs. LLNL would follow prevention and mitigation steps outlined in the spill response chapter of the ES&H Manual in the event of a hazardous material spill. Because the minimum depth to groundwater at the Livermore Site is approximately 30 feet and employees are trained in spill response procedures, spills would likely be cleaned up before they reach the water table.

Impacts to groundwater from leaking underground storage tanks would not be expected since LLNL complies with all underground storage tank regulations which enforce the use of tank and

pipings primary and secondary containment, detection and monitoring systems, and corrosion protection.

No negative impacts to groundwater at the Livermore Site are expected from operations under the No Action Alternative, because there would be no discharges to groundwater. Impacts to groundwater quality from surface water recharge would be minimal because LLNL would continue to comply with NPDES requirements.

Site 300

Surface Water

Under the No Action Alternative, construction of buildings and roads would contribute incremental additions to impervious surfaces. There would be no noticeable impact to groundwater recharge because Site 300 is largely undeveloped and not covered by impervious surfaces. Stormwater monitoring would continue in accordance with NPDES requirements. Water use is expected to continue at 0.35 million gallons per day under the No Action Alternative.

Surface water resources could be degraded by contaminant releases during construction of new facilities. Contaminant sources could include construction materials, spills of oil and diesel fuel, and releases from transportation or waste-handling accidents. LLNL would follow mitigation steps outlined in the Spill Prevention Control and Countermeasures (SPCC) Plan in the event of a spill of petroleum products. Hazardous material spill response procedures are outlined in the ES&H Manual.

Compliance with an approved erosion and sedimentation control plan during construction would prevent impacts to surface water from construction-induced erosion.

None of the No Action Alternative projects would contribute significant amounts of surface water runoff to cause substantial flooding. The 100-year base flood event would be contained within all channels except along Corral Hollow Road near the GSA, where parts of the road would be inundated during the 100-year event. Due to the high infiltration rates and lack of appreciable floodplains at Site 300, hydrologic impacts under the No Action Alternative would be minimal. However, due to the steep slopes, high runoff velocities within channels could occur during a storm. No facilities would be located in these areas; therefore, no impact from flooding would be expected.

Groundwater

Groundwater contaminants of concern at Site 300 include VOCs (mainly trichloroethylene), tritium, depleted uranium, explosive compounds, nitrate, and perchlorate. By fall 1999, after 8 years of treatment, the eastern GSA offsite trichloroethylene plume had been restricted to the Site 300 property. Before treatment, the plume had extended more than a mile down the Corral Hollow stream channel in the direction of the city of Tracy. Under the No Action Alternative, groundwater quality would continue to improve with ongoing remediation activities at Site 300.

Groundwater resources could be degraded by contaminant releases during construction. Contaminant sources could include construction materials; spills of hydraulic fluid, oil, and diesel fuel; and releases from transportation or waste handling accidents. LLNL would follow mitigation steps outlined in the SPCC Plan, in the spill response chapter of the ES&H Manual in the event of an oil or hazardous material spill. The potential for spills of hazardous materials to affect groundwater largely depends on the depth to groundwater where the spill occurs. Depths to groundwater in the areas where activities are expected under the No Action Alternative vary from approximately 50 to 180 feet. Because the minimum depth to groundwater at Site 300 in areas where activities are expected under the No Action Alternative is approximately 50 feet and employees are trained in spill response procedures, spills would likely be cleaned up before they reach the water table.

Impacts to groundwater from leaking underground storage tanks would not be expected since LLNL complies with all underground storage tank regulations which enforce the use of tank and piping primary and secondary containment, detection and monitoring systems, and corrosion protection.

No negative impacts to groundwater at Site 300 would be expected from operations under the No Action Alternative because there would be no discharges to groundwater. Potential impacts to groundwater quality from surface water recharge would be minimal because LLNL would continue to comply with NPDES requirements. Groundwater use would continue as described in Section 4.11, and no impacts to groundwater availability would be expected under the No Action Alternative.

5.2.9.3 *Cumulative Impacts*

Livermore Site

The San Francisco Public Utilities Commission provides water to 2.4 million people in San Francisco, San Mateo, Santa Clara, and Alameda counties, including the Silicon Valley business district. To maintain a reliable water system, the San Francisco Public Utilities Commission initiated regional and local water projects in 2003 to upgrade and repair Hetch Hetchy System facilities. These projects will ensure stability in the case of a seismic event, sufficient water supply for an increasing population, and high quality drinking water that meets all regulatory requirements. The improvements scheduled to be complete by 2016.

San Francisco Bay Area water use is expected to increase by 64 million gallons per day by the year 2030. This is approximately a 25 percent increase over current water usage. The Livermore Site is projected to use 1.37 million gallons per day under the No Action Alternative. This is 0.4 percent of the projected total Hetch Hetchy water supply. Livermore currently uses 0.5 percent of the Hetch Hetchy water supply. Livermore's future contribution to the cumulative Hetch Hetchy water use would remain proportional to current use.

Because much of the land surrounding the Livermore Site is zoned for low-density activities such as grazing, vineyards, and rural residential, and the large residential parcel to the west of the Livermore Site is basically fully developed (see Chapter 4, Figure 4.2.1.1–1), it is expected that most of the surrounding undeveloped land will not be converted to impervious surfaces in future

years. Therefore, cumulative impacts on surface water quality and groundwater recharge from increases in impervious surfaces are expected to be minimal.

With the exception of the Livermore Site VOC plumes, no other known contaminant plumes exist in the surrounding area that could cause a cumulative degradation of groundwater quality. Other sources of groundwater contamination in Livermore are described in Section 5.2.15.3. Groundwater quality at SNL/CA, located directly south of the Livermore Site, has improved through completion of remediation that began in 1984 on a 59,000-gallon diesel fuel spill. Similarly, groundwater quality should continue to improve in the Livermore Site vicinity with ongoing remediation at water treatment facilities.

Site 300

Site 300 currently receives water from onsite wells and should receive water from the Hetch Hetchy water supply system by early 2004. Water consumption rates have declined steadily since 1992, down to 25.3 million gallons per year in 2002. The new water system capacity is estimated to be 648,000 gallons per day, with the capability of expanding to 1.2 million gallons per day. Under the No Action Alternative, Site 300 would use 0.1 percent of the Hetch Hetchy water supply. Given the low population and rural character of the area, an indiscernible increase in water use under the No Action Alternative, and the eventual Hetch Hetchy supply, no cumulative impacts to water availability for Site 300 and vicinity would be expected.

The land surrounding Site 300 is designated as general agricultural, recreation, conservation, and wind resource areas (see Figure 4.2.1.2–1). Most of this land is agricultural, however, property immediately east of the site is occupied by a company that packages and stores fireworks. The Carnegie State Vehicular Recreation Area, southwest of the site, is used for off-highway vehicles. Aside from the vehicle recreation area, which likely contributes to sediment runoff during rainstorms, the cumulative impact on surface water quality from activities in surrounding areas would be minimal. Because the area is largely undeveloped and expected to continue in that manner, no cumulative impacts to groundwater recharge would be expected.

Groundwater contamination at Site 300 has been restricted to within the site boundary and groundwater quality is improving through remediation activities. Because these plumes are the only known groundwater contamination in the Site 300 vicinity, no cumulative impacts to groundwater quality would be expected.

5.2.10 Noise

This section presents noise impacts resulting from implementation of the No Action Alternative. The analysis is organized by noise-generating LLNL activities, such as construction, modifications to and removal of facilities, traffic noise, and impulse noise.

5.2.10.1 *Relationship with Site Operations*

Activities associated with the No Action Alternative (Section 3.2) would contribute to noise generation, either directly or indirectly. These noise-generating activities include:

- **Construction Activities and Equipment**—Demolishing, excavating, grading, and building that can result in intermittent noise levels generally higher than background.
- **Operating Equipment**—A variety of machinery and equipment items that generate noise during routine operations including heating, ventilating, and air-conditioning (HVAC) equipment; cooling towers; motors; pumps; fans; generators; and air compressors.
- **Traffic**—The Livermore Site generates about 22,000 vehicle trips per day (counting each vehicle to enter and exit the Livermore Site) and an additional 500 trips per day are generated by Site 300.
- **Explosives Testing**—Explosives testing results in short-burst, impulse-type noise.

The general parameters that will be used to characterize activities with potential to characterize community noise levels are listed in Table 5.2.10.1–1.

5.2.10.2 *Impact Analysis*

As described in Section 3.2, the No Action Alternative would encompass continued operation of many current LLNL activities, but also include planned facility and infrastructure improvements, the completion of several construction projects, additional staffing, operation of planned facilities, and several building removals.

Modifications to Facilities or Operations

Facility and infrastructure renovations and new facility construction are ongoing activities at the Livermore Site and Site 300. The projected level for these construction activities under the No Action Alternative would remain on par with current levels. The impact of these activities would not generally be noticeable beyond the site boundary, owing to the relatively large spatial area of the Livermore Site and perimeter buffer zone. Intervening roadways between Livermore Site, Site 300, and community areas would reduce the impact of onsite generated noise.

Planned new facilities associated with the No Action Alternative would be primarily offices and laboratories, and would not introduce any machinery or equipment that would differ from the current HVAC equipment, cooling towers, motors, pumps, fans, generators, air compressors, and loudspeakers. Noise from this equipment would not be noticeable beyond the site boundary.

At most, during peak activity levels, a person located 100 feet from a noisy construction site would not be exposed to more than 82 A-weighted decibels (dBA), for only limited periods of maximum activity. This level is comparable to a pneumatic drill or vacuum cleaner (City of Livermore and LSA 2002) and is not expected to be objectionable or to conflict with compatibility guidelines. Impacts are expected to be minimal.

Traffic Noise

The No Action Alternative would result in a slight increase in heavy-duty vehicle activity related to shipments of materials and waste. This equipment is associated with noise levels of 81 to 87 dBA at 50 feet. Although intermittent, because they traverse roads outside the site, they are nearer to community receptors and more likely to be noticeable to the offsite community than operations conducted well within the site. As stated in Chapter 4, Section 4.12, vehicles serving LLNL are subject to requirements that they be properly muffled to reduce noise impacts, and their activities are limited to times that are both less noticeable and less objectionable.

Planned activities associated with the No Action Alternative would involve a projected increase in the workforce, adding approximately 290 employees at the Livermore Site by the year 2014, and possibly 10 employees at Site 300, and a corresponding increase in vehicular activity (approximately 3 percent above current levels), primarily workers commuting to and from the sites. The additional traffic would add slightly to ambient noise levels. To help alleviate this impact, LLNL is committed to continue promoting and expanding its Transportation Systems Management Program to aid in providing viable alternatives to employee commuting, thereby reducing traffic congestion and noise (LLNL 2001s).

Impulse Noise

LLNL would continue explosives research testing under the No Action Alternative at both the Livermore Site, within the Building 191 High Explosives Application Facility; and at Site 300, within the Contained Firing Facility and on open firing tables. The number of blasts and intensity would not change; therefore, impacts would be the same as under current operations. LLNL would continue to use blast forecasting as a tool to determine if explosive tests would adversely affect the surrounding community and to restrict operations when peak-impulse noise levels are predicted to exceed the 126-dBA level in populated areas. LLNL would also continue to perform meteorological monitoring to provide necessary input data for blast forecasting (LLNL 2001s).

Decommissioning, Decontamination, and Demolition

The No Action Alternative would include removal of 234,443 gross square feet of excess and legacy facilities at the Livermore Site and 20,202 gross square feet at Site 300. This rate would be similar to that of recent years and, with the relatively large spatial area and perimeter buffer zone, noise from these activities would not be discernible in offsite areas.

5.2.10.3 Cumulative Impacts

As stated, planned activities associated with the No Action Alternative would include a projected increase in the workforce, adding 290 employees at the Livermore Site and possibly 10 employees at Site 300. Although the jobs that would be created under the No Action Alternative at LLNL represent a very small fraction (less than 1 percent) of the projected increase in employment within Alameda County over the 2000-2010 timeframe (Association of Bay Area Governments 2001), as described in Section 5.1.2, the additional workforce would include some relocated employees new to the Bay Area. Activities and services to support the relocated population would contribute to local noise levels, both short-term in areas of increased construction activities, and long-term, associated with increased development, density of population and commercial activities, and vehicular traffic and congestion.

Local noise ordinances and restrictions on allowable noise levels, as stated in terms of land use compatibility guidelines for community noise environments, discussed in Chapter 4, Section 4.12.1.2, would limit the impact of additional noise sources on the local community. The city of Livermore is currently working on several elements of its General Plan, and may consider additional restrictions based on key findings related to noise (City of Livermore and LSA 2002). With Livermore's anticipated growth in the future, noise levels are expected to increase due to potential increases in Livermore's current key noise sources: construction activity, development, vehicular activity, and rail and aviation operations. Noise levels from potential mixed use and infill development in Livermore, especially in the downtown, could exceed noise level guidelines as a result of land use incompatibilities.

5.2.11 Traffic and Transportation

Traffic congestion and collective dose and LCFs to the general population from radiological shipments were analyzed. The estimate of traffic congestion is based on the change in employment under the No Action Alternative compared to current operations. Radiological

consequences were calculated using DOE transportation models as described in Section 5.1.11. Appendix J of this LLNL SW/SPEIS details the methodology and important inputs for radiological transportation analysis.

5.2.11.1 *Relationship with Site Operations*

Section 3.2 describes the projects under the No Action Alternative. These projects, when combined with current LLNL operations, would result in increased radiological transportation. Although not every individual shipment was accounted for, the larger and more important shipment campaigns analyzed would result in approximately 260 shipments of special nuclear material, 61 shipments of LLW and MLLW, 5 tritium shipments, and 13 TRU waste shipments per year. See Appendix J, Section J.5.2, for more details. These values are considerably larger than for current operations (see Appendix J, Section J.5.1) due to shipment campaigns analyzed under previous national programmatic EISs, but only now beginning to be implemented.

5.2.11.2 *Impact Analysis*

Livermore Site

Under the No Action Alternative, LLNL employment would rise by approximately 300 workers. This 3 percent increase over current operations with 10,350 workers would not have any impact on local traffic. There would be minimal construction under this alternative as well. No Action Alternative projects with large construction activities (such as the NIF and the Terascale Simulation Facility) would be completed before the period of analysis for this LLNL SW/SPEIS. Other No Action Alternative construction projects would be small and, in total, would be much less than the current magnitude of construction. However, the level of radiological transportation would increase under the No Action Alternative.

Radiological shipments under the No Action Alternative would include shipments of the following:

- Special nuclear material approved under the *Programmatic Environmental Impact Statement for Stockpile Stewardship and Management* (SSM PEIS) (DOE 1996a) and the *Surplus Plutonium Disposition Environmental Impact Statement* (DOE 1999c)
- TRU waste to the Waste Isolation Pilot Plant (WIPP) under *Waste Isolation Pilot Plant Final Supplemental Environmental Impact Statement* (DOE 1997e)
- Shipments of tritium for high-energy density physics target fill and the test readiness program targets for the NIF
- Shipments of LLW under the *Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (DOE 1997f)
- Several other smaller shipment campaigns

Table 5.2.11.2–1 presents the collective dose to the general population from these shipments. The number of LCFs for the No Action Alternative would be 4×10^{-3} per year. See Appendix J, Sections J.5 and J.6, of this LLNL SW/SPEIS for detailed calculations of the person-rem per year.

TABLE 5.2.11.2–1.—Collective Dose to the General Public from Radioactive Shipments Under the No Action Alternative

Shipment Type	Collective Dose (person-rem per year)			
	Along Route	Sharing Route	At Stops	Total
LLW	0.11	1.2	0.55	1.8
TRU waste	9.9×10^{-2}	1.2	0.55	1.9
Materials ^a	0.21	2.3	1.1	3.7
Total No Action	0.42	4.7	2.2	7.4
Current operations	7.1×10^{-2}	0.76	0.37	1.2

^aNonwaste radioactive materials, including special nuclear materials, tritium, and other materials used in the LLNL mission.
LLW = low-level waste; TRU = transuranic.

Site 300

Under the No Action Alternative, there would be minimal changes in traffic and transportation at Site 300, compared to current operations and no incremental impacts expected from current conditions as described in Chapter 4.

5.2.11.3 Cumulative Impacts

Traffic congestion in the Tri-Valley Area is very heavy and will likely increase due to growth in the area. Any increases in LLNL employment under the No Action Alternative would, however small, contribute to this congestion. Given the negligible contribution of the No Action Alternative and current LLNL traffic to the overall congestion problem, detailed analysis of the cumulative traffic impacts is not warranted. However, LLNL's contribution to radiological impacts in the vicinity of LLNL is not a small percentage of overall radiological impacts. Therefore, this cumulative impacts analysis focuses on collective dose from radiological transportation. The analysis considers LLNL radiological transportation cumulative with SNL/CA radiological transportation.

NNSA performed a RADTRAN 5 analysis for 3.5 miles of highway in the Livermore area where all radiological shipments would converge. For conservatism, the shipments were comprised of the larger set of shipments in the Proposed Action resulting in 7.6×10^{-2} person-rem per year and those from SNL/CA resulting in 1.2×10^{-3} person-rem per year. The resulting collective dose is 7.7×10^{-2} person-rem per year, corresponding to 5×10^{-5} LCFs per year. The No Action Alternative cumulative impacts would be less than these values. More information on the calculation is presented in Appendix J, Section J.7. Minimal impacts would be expected as a result of these doses.

5.2.12 Utilities and Energy

This section discusses the potential impacts of the No Action Alternative on utilities and energy supplies. Utility and energy usage are discussed separately for the Livermore Site and Site 300. LLNL-leased properties (i.e., Almond Avenue, Graham Court, Patterson Pass, and Arroyo Mocho Pump Station) are considered part of the Livermore Site in assessing utility and energy impacts.

5.2.12.1 Relationship with Site Operations

This section summarizes the relationship between projects described in Section 3.1 for the No Action Alternative and the utilities and energy analysis. In general, the effects of projects for the No Action Alternative on utilities and energy analyses are related to water consumption, sewage discharges, electricity consumption, and fuel consumption resulting from design, construction, and operation of projects under the No Action Alternative.

5.2.12.2 Impact Analysis

Water Consumption

Livermore Site

In 2002, the Livermore Site used approximately 212 million gallons of water. As the NIF (110,000 gallons per day) and the Terascale Simulation Facility (60,000 gallons per day) become operational, water use at the Livermore Site would increase by 30 percent to approximately 276 million gallons per year (LLNL 2003an). Accordingly, peak water use would increase from 1.2 million gallons per day to approximately 1.37 million gallons per day. The capacity of the Livermore Site domestic water system in the year 2002 was approximately 2.88 million gallons per day. Because the Livermore Site domestic water system has adequate capacity to meet future water demands under this alternative, impacts would be minimal.

Site 300

Average water consumption at Site 300 is 67,900 gallons per day (LLNL 2003aq). No changes in square footage at Site 300 are planned under this alternative; therefore, the current water use at Site 300 is considered to be representative of future consumption rates for the No Action Alternative. No additional impacts are expected.

Sewer Discharges

Livermore Site

The LWRP currently receives a total of approximately 6.5 million gallons of effluent per day. The capacity of this facility is 8.5 million gallons of effluent per day, which is expected to be sufficient for inflow treatment for the foreseeable future. The Livermore Site discharges approximately 216,400 gallons per day (3.3 percent of the volume received by the LWRP) to the sanitary sewer system based on 2002 estimates.

Under the No Action Alternative, sewer discharge would increase by 3.5 percent over the existing environment to approximately 224,000 gallons per day based on the projected increase in square footage and personnel at the Livermore Site. Impacts from this 3.5 percent increase in sewer discharges from the Livermore Site would be minimal.

Site 300

Site 300 sanitary sewage generated outside the GSA is disposed of through septic tanks and leach fields or cesspools at individual building locations. Sanitary sewage generated within the GSA is piped into an asphalt-membrane-lined oxidation pond east of the GSA at an average rate of 2,100 gallons per day.

Currently, Site 300 discharges approximately 2,100 gallons of sewage per day. No changes in square footage at Site 300 are planned under this alternative; therefore, current discharges are considered to be representative of future rates for the No Action Alternative. No offsite sewage treatment is conducted for Site 300 wastes and no new impacts are expected.

Electricity Consumption

Livermore Site

The projected peak electrical demand at LLNL would be 82 megawatts under the No Action Alternative. Growth at the Livermore Site would result in increased electricity consumption. Electricity consumption at the Livermore Site averages approximately 321 million kilowatt-hours per year and has remained stable over the past 5 years. With the added loads from the NIF and the Terascale Simulation Facility, electric power consumption is expected to increase by 39 percent to approximately 446 million kilowatt-hours per year. The LLNL distribution system and existing capacity for the utilities to supply energy on both a total and a peak load basis would adequately meet the projected increase in consumption, but may limit future development at the site.

Site 300

Electricity consumption at Site 300 is approximately 16.3 million kilowatt-hours per year and has remained stable over the past 5 years (LLNL 2003aq). No changes to Site 300 square footage are planned under this alternative; therefore, current electrical power consumption at Site 300 is considered to be representative of future consumption rates for the No Action Alternative. Therefore, no additional impacts are expected.

Fuel Consumption

Livermore Site

Natural gas consumption for the Livermore Site averages 12,900 therms per day. Consumption rates are expected to increase to approximately 23,300 therms per day as the NIF and Terascale Simulation Facility become operational (LLNL 2003b). The No Action Alternative projects an additional 1.5 percent increase to 23,600 therms per day in natural gas consumption based on the

projected increase in gross square footage of developed space at LLNL in the foreseeable future. This would result in minimal additional impact.

No change in diesel fuel or unleaded gasoline is anticipated. Diesel fuel and unleaded gasoline use would remain at 72,200 gallons per year and 451,800 gallons per year, respectively.

Site 300

Site 300 fuel oil consumption is approximately 16,600 gallons per year (LLNL 2003aq). No changes in the gross square footage at Site 300 are planned under this alternative; therefore, current fuel oil consumption is considered to be representative of future consumption rates for the No Action Alternative.

5.2.12.3 Cumulative Impacts

Water Consumption

Livermore Site

The No Action Alternative together with other development in the Hetch Hetchy service area would increase demand for and consumption of water. For example, the population in Alameda County is projected to increase by about 17 percent by the year 2015 (DOF 2001). Residential, commercial, industrial, and other uses in Alameda County are expected to increase proportionally. Other counties in the Hetch Hetchy service area would experience similar growth. This population growth in the Hetch Hetchy service area in conjunction with the 30 percent increase in water use at the Livermore Site would constitute a cumulative impact upon water resources and supply systems.

Site 300

Current water use at Site 300 is considered to be representative of future consumption rates for the No Action Alternative. However, development in the vicinity of Site 300 would increase demand for and consumption of water. Population in San Joaquin County is projected to increase 30 percent by the year 2015 (DOF 2001). Residential, commercial, industrial, and other uses in San Joaquin County are expected to increase proportionally. This growth would constitute a substantial cumulative impact on groundwater resources. Similarly, population growth in the Hetch Hetchy service area would constitute a cumulative impact upon water resources in the area.

Sewer Discharges

Livermore Site

The No Action Alternative, together with other developments in the area, would increase demand for sewage services. Population in Alameda County is projected to increase by about 17 percent by the year 2015 (DOF 2001). Residential, commercial, industrial, and other uses in Alameda County are expected to increase proportionally. The LWRP currently receives a total of approximately 6.5 million gallons of effluent per day. While existing LWRP capacity of 8.5

million gallons per day is expected to be sufficient for inflow treatment for the next 10 years, sewage treatment facility improvements are being planned in the region. Population growth would constitute a cumulative impact on sewage systems in the area.

Site 300

Because Site 300 sewer discharge and treatment programs are mostly self-contained, no cumulative impact is expected as a result of the No Action Alternative.

Electricity Consumption

Livermore Site

The No Action Alternative, together with other developments in the area, would increase electric power demand. Population in Alameda County is projected to increase by about 17 percent by the year 2015 (DOF 2001). Residential, commercial, industrial, and other uses in Alameda County are expected to increase proportionally. This population growth in conjunction with the 39 percent increase in demand for electrical power at the Livermore Site could constitute an adverse cumulative impact on electric power resources in the area. Currently, electric utilities provide approximately 10,605 million kilowatt-hours per year of electricity to Alameda County (CEC 2001). However, more than 10,000 megawatts of new electric generation capacity is planned in the Pacific Gas and Electric (PG&E) service area. Additional generating capacity is planned throughout the State of California and surrounding states (CEC 2000). Expanded electric transmission capability is also planned in the region. If implemented as planned, these additions would provide sufficient capacity to meet Alameda County electrical energy needs for the next 10 years, thus any negative impacts would be mitigated.

Site 300

Current electric power consumption at Site 300 is considered to be representative of future consumption rates for the No Action Alternative. However, the population in San Joaquin County is projected to increase 30 percent by the year 2015 (DOF 2001). Residential, commercial, industrial, and other electric power uses in San Joaquin County are expected to increase proportionally. This growth could constitute a substantial cumulative impact on electric power resources in the area. Currently, electric utilities provide approximately 5,106 million kilowatt-hours per year of electricity to San Joaquin County (CEC 2001). However, more than 10,000 megawatts of new electric generation capacity is planned in the PG&E service area. Additional generating capacity is planned throughout the State of California and surrounding states (CEC 2000). Expanded electric transmission capability is also planned in the region. If implemented as planned, these additions would provide sufficient capacity to meet San Joaquin County electrical energy needs for the next 10 years and mitigate the impact of growth in the region.

Fuel Consumption

Livermore Site

The No Action Alternative, together with other developments in the PG&E service area, would increase the demand for natural gas. Population in Alameda County is projected to increase by about 17 percent by the year 2015 (DOF 2001). Residential, commercial, industrial, and other uses in Alameda County are expected to increase proportionally. This population growth could constitute an adverse cumulative impact on natural gas supply systems. However, PG&E's transmission capacity is approximately 130 percent of the demand for natural gas in its service area (CPUC 2001). As required by the California Public Utilities Commission, PG&E uses a 15-year planning horizon for gas transmission and storage capacity and a 10-year planning horizon for local gas distribution systems. Accordingly, PG&E plans to provide sufficient capacity to meet Alameda County needs for the next 10 years. Therefore, any impacts would be mitigated.

Site 300

Current fuel oil consumption at Site 300 is considered to be representative of future consumption rates for the No Action Alternative. However, the population in San Joaquin County is projected to increase 30 percent by the year 2015 (DOF 2001). Fuel oil use in San Joaquin County is expected to increase as the population increases, but at a lower rate. This growth could constitute an adverse cumulative impact on fuel oil supplies in the county. However, overall fuel oil use in the State of California has declined substantially as air quality regulations concerning greenhouse gas emissions become more stringent. Consequently, fuel oil delivery systems within San Joaquin County have large amounts of excess capacity. This excess capacity is sufficient to meet San Joaquin County requirements for the next 10 years. Therefore, any impacts would be mitigated.

5.2.13 Materials and Waste Management

5.2.13.1 *Materials Management*

This section provides an overview of management responsibilities regarding receipt, transfer, and shipment of radioactive, controlled, and hazardous materials under the No Action Alternative. Appendices A, B, D, M, and N include descriptions of programs and buildings associated with the use of these materials, which historically has resulted in both their planned and inadvertent releases to the environment.

The consequences of using radioactive, controlled, and hazardous materials are discussed in the sections associated with the affected media. For example, releases to the air associated with use of radioactive materials are discussed in Section 5.2.9 and releases affecting vegetation are discussed in Section 5.2.8. The workplace use of these materials and associated occupational exposures are discussed in Section 5.2.14.

Relationship with Site Operations

Several new operations are currently in the planning stages at LLNL. However, they were considered outside of the scope of the existing conditions for this LLNL SW/SPEIS because they

had not yet reached operational status. New operations are defined as programmatically planned projects with implementation schedules that will take place in the future, such as the NIF. The No Action Alternative would include all new operations, D&D projects, and other activities identified in Section 3.1. In general, material usage at LLNL would increase consistent with a 3 percent increase in LLNL operations above the existing conditions.

Waste minimization and pollution prevention techniques would be expected to offset a portion of the projected increase. Average maximum quantities would likely remain constant as material storage space remains constant; however, average quantities would be expected to increase to meet demand. Under the No Action Alternative, material projections used for analysis would not exceed existing material management capacities.

Impact Analysis

The No Action Alternative would not cause any major changes in the types of materials used onsite. Material usage at LLNL would increase consistent with a 3 percent increase in laboratory operations over existing conditions. Waste minimization and pollution prevention techniques would offset a portion of the projected increase. Average maximum quantities would likely remain constant as material storage space remains constant; however, average quantities would increase to meet demand. Under the No Action Alternative, material projections used for analysis would not exceed existing material management capacities.

Existing Operations

Under the No Action Alternative, total hazardous material usage would increase for existing facilities. Average quantities would increase by an estimated 3 percent above current conditions. Annually, approximately 171,000 to 192,000 chemical containers, ranging from 210-liter (55-gallon) drums to gram-quantity vials, would be used or stored at LLNL.

Annually, for the Livermore Site, approximately 70,000 gallons of liquids would be managed under the No Action Alternative with an estimated storage capacity of 227,000 gallons. Approximately 1.4 million pounds of solids would be handled with a storage capacity of 2.4 million pounds. Solid material storage would not be expected to fluctuate because metals (e.g., lead used for shielding) are less likely to be consumed and more likely to be reused and reclaimed. Regardless, there would be sufficient capacity to accommodate anticipated operations. Approximately 1.1 million cubic feet of mostly industrial gases (argon, helium, hydrogen, oxygen, nitrogen) would be used annually with a storage capacity of 71.6 million cubic feet. Projections for specific hazardous chemicals for existing Livermore Site operations and Site 300 operations are presented in Tables 5.2.13.1–1 and 5.2.13.1–2, respectively. Additional details are provided in Appendix B.

TABLE 5.2.13.1–2.—Types of Hazardous Chemicals in Use at Site 300 Under the No Action Alternative

Chemical	Chemical Abstract Number	Baseline Average Maximum/Average Quantity	No Action Average Maximum/Average Quantity
Paints/Solvents			
Paint (variety)	NA	7,200/1,200 lb	7,200/1,230 lb
Thinner, lacquer	NA	310/95 gal	310/125 gal
Methyl alcohol	67-56-1	90/5 gal	90/5 gal
Acetone	67-64-1	400/30 gal	400/35 gal
Metals			
Lead bricks or ingots	NA	25,000 lb	25,000 lb
Acids/Bases/Oxidizers			
Oxygen, compressed	7782-44-7	16,000/5,000 ft ³	16,000/5,150 ft ³
Sulfuric acid	7664-93-9	845/60 lb	845/62 lb
Cyanuric acid	108-80-5	500/50 lb	500/52 lb
Industrial Gases			
Argon, compressed	7440-37-1	30,000/30,000 ft ³	30,000/30,000 ft ³
Helium	7440-59-7	25,000/25,000 ft ³	25,000/25,800 ft ³
Hydrogen, compressed	1333-74-0	700/700 ft ³	700/720 ft ³
Nitrogen, compressed (Liquified, gaseous)	7727-37-9	312,000/280,000 ft ³	312,000/288,000 ft ³
Carbon dioxide	124-38-9	44,000/5,000 ft ³	44,000/5,200 ft ³
Refrigerants			
Freon 113 (1,1,2-Trichloro-1,2,2-trifluoroethane)	76-13-1	150/10 gal	150/10 gal
Freon 22 (Chlorodifluoromethane)	75-45-6	1,400/870 lb	1,400/910 lb
Freon 12 (Dichlorodifluoromethane)	75-71-8	660/220 lb	660/230 lb
Freon 13 (Chlorotrifluoromethane)	75-72-9	478/478 ft ³	492/492 ft ³
Freon 14 (Tetrafluoromethane)	75-73-0	2,000/500 ft ³	2,000/515 ft ³

Source: LLNL 2002w; TtNUS 2003.

Note: Additional chemicals are listed in Appendix B.

ft³ = cubic feet; lb = pounds; gal = gallons, NA = not available.

Increases in overall radioactive materials and explosive materials based on current administrative limits are expected; however, no new material storage facilities would be built as a result of these projected increases. Detailed safety documentation would be required in most cases prior to implementation of increased inventories of these controlled materials. For a discussion of potential accidents, materials limits, and materials-at-risk, see Section 5.5, Bounding Accident Scenarios. Under the No Action Alternative, radioactive material and explosive material requirements would not exceed existing material management capacities (TtNUS 2003); therefore, no additional impacts are expected.

New Operations

LLNL anticipates hazardous material usage rates to increase for the foreseeable future. The majority of the increase would be due to the full implementation of NIF and BSL-3 operations (Table 5.2.13.1–3). New LLNL operations would account for approximately 70,000 gallons of liquids and approximately 20,000 standard cubic feet of industrial gases. Materials expected to support other projects, including D&D projects, are described in Tables 5.2.13.1–3 and 5.2.13.1–4. For new facilities, no additional impacts would be expected since each of the new facilities would be designed to handle expected quantities.

Under the No Action Alternative, several construction projects, D&D projects, renovation projects, and new operations would begin. Site material usage would increase slightly because of the new operations. See Appendices A and B of this LLNL SW/SPEIS for more information.

Cumulative Impacts

The ROI for materials management involves LLNL and its facilities, as presented in Chapter 4 of this LLNL SW/SPEIS.

The ROI for cumulative impacts is larger than that presented in Chapter 4 and considers the contributions of LLNL (Livermore Site and Site 300), SNL/CA, NNSA, local projects and activities, and the State of California. NNSA assessed cumulative impacts by combining the potential effects of the No Action Alternative with the effects of other past, present, and reasonably foreseeable activities in the ROI. The No Action Alternative was chosen to assess and present a bounding scenario of potential cumulative effects. This approach allowed a conservative analysis or a maximum estimation of cumulative impacts (see Section 5.3.13.1).

5.2.13.2 *Waste Management*

This section provides an overview of management responsibilities for generation, storage, treatment, and disposal of radioactive, hazardous, mixed, and other wastes, including biohazardous and D&D wastes at LLNL under the No Action Alternative. Appendices B, M, and N include descriptions of wastes and facilities associated with use, generation, and management of these wastes.

The consequences of managing radioactive and hazardous wastes are discussed in the sections associated with the affected media. For example, releases affecting vegetation are discussed in Section 5.2.7, Biological Resources, and releases (treatment processes) to the air associated with use of radioactive materials are discussed in Section 5.2.8, Air Quality. The workplace use of these materials and associated occupational exposures are discussed in Section 5.2.14, Human Health and Safety.

TABLE 5.2.13.1–3.—Types of Hazardous Materials in Use with New Operations Under the No Action Alternative

Project Title	Hazardous Materials Expected
BioSafety Level-3 Facility	Small amounts of biotoxins associated with the cultured microorganisms. Typical bench-scale laboratory chemicals (solvents, acids, bases, basic elements, formaldehyde, chloroform, phenol, ethyl alcohol, isopropyl alcohol, sodium hydroxide, potassium hydroxide, and other routine industry-related sterilizing chemicals or cleaning agents). The quantities of chemicals would be well below the reportable quantity thresholds in SARA.
BioSafety Laboratories	Upgrading a series of buildings would include using BSL-1 and BSL-2 materials. Typical bench-scale laboratory chemicals (solvents, acids, bases, basic elements, formaldehyde, chloroform, phenol, ethyl alcohol, isopropyl alcohol, sodium hydroxide, potassium hydroxide, and other routine industry-related sterilizing chemicals or cleaning agents). The quantities of chemicals would be well below the reportable quantity thresholds in SARA.
Tritium Facility Modernization	Operations to support hydrogen isotope research. Tritium and typical bench-scale laboratory chemicals. The small quantities of chemicals would be used in demonstrating simple chemical reactions.
Site 300 Tritium Use	Tritium use.
Reclassify Building 446 as BSL-2 and other facilities	Upgrading facilities would include using BSL-1 and BSL-2 materials. Typical bench-scale laboratory chemicals (solvents, acids, bases, basic elements, formaldehyde, chloroform, phenol, ethyl alcohol, isopropyl alcohol, sodium hydroxide, potassium hydroxide, and other routine industry-related sterilizing chemicals or cleaning agents). The quantities of chemicals would be well below the reportable quantity thresholds in SARA.
Terascale Simulation Facility	Computer related materials.
Engineering Technology Complex Upgrade	No changes.
Central cafeteria replacement	Cleaning compounds.
International Security Research Facility	New building, limited to cleaning materials and office supplies.
Container Security Testing Facility	Neutron diagnostics, sealed sources.
Site 300 as a Response Training Facility	
National Ignition Facility	Targets and other materials (see Appendix M).
WIPP Mobile vender	Shipping function being prepared.

Source: TtNUS 2003.

SARA = *Superfund Amendments and Reauthorization Act* of 1986; SNM = special nuclear material; TRU = transuranic; WIPP = Waste Isolation Pilot Plant; BSL = BioSafety Level.

TABLE 5.2.13.1–4.—Listing of Materials in Use with Decontamination and Decommissioning, Construction, Upgrades, and Other Improvements Under the No Action Alternative^{a, b, c}

Material Usage Description
Acoustical ceiling, acoustical insulation, acrylic, additives, adhesives, asphalt, bonding agent, carpet and padding, caulking, ceramic, cleaners, concrete, coolants, fillers, glazing, glues, gypsum wallboard, insulating paints, insulation, joint compounds, latex, metal ceiling, oils, paints, pipes, primer, putties, quarry and conductive tile, reducers, roofing materials, roofing materials, sealants, sealer, soil, solder, solvents, spackling, sprayed fireproofing, structural metals, tile grout, tubes, wallpaper supplies, waterproofing, wiring, and wood finishing.

Source: TtNUS 2003.

^a Examples of D&D projects include Buildings U325, 222S, 514, cleanup of 292.

^b Examples of Construction projects include routinely remove and replace offices throughout LLNL.

^c Examples of Upgrades include Biological Safety and Security Laboratory project covering Buildings 132N, 151, 154, 235, 241 (for BSL level 1 and 2), Buildings 190, 281, 432, 435, 446 (for BSL level 1 and 2), Building 132S (for BSL level 1 and 2), Buildings 153 and T1527 (for BSL level 1 and 2), reroofing a series of buildings, Building 332 ductwork replacement, Site 300 Revitalization, Site 300 Wetlands Enhancement, East Avenue, Superblock Security Upgrade, Engineering Technology Complex Upgrade, building utilities, seismic, other road upgrades, site utilities upgrades.

D&D = decontamination and decommissioning.

Relationship with Site Operations

Several new operations are currently in the planning stages at LLNL; however, they were considered outside the scope of the existing conditions for this LLNL SW/SPEIS because they had not yet reached operational status. New operations are defined as programmatically planned projects with defined implementation schedules that will take place in the future, such as the NIF. The No Action Alternative would include all new operations, D&D projects, and other activities, including permit modifications, identified in Section 3.1. In general, waste generation at LLNL would increase, consistent with a 3 percent increase in LLNL operations above the existing conditions.

Waste minimization and pollution prevention techniques would be expected to offset a portion of the projected increase assessments. Under the No Action Alternative, waste generation projections used for analysis would not exceed existing waste management capacities.

Impact Analysis

Under the No Action Alternative, ongoing NNSA and interagency programs and activities at LLNL would continue operating at planned levels as reflected in current NNSA management plans for 2004 through 2014 (e.g., recent Class 1 and Class 2 Permit Modification submittals). The Decontamination and Waste Treatment Facility (DWTF) use would increase by implementing planned permit modifications as identified below. In some cases, projected waste generation levels would include increase over current waste generation levels (e.g., NIF contributions). These would include increases for any recent activities that have already been approved by NNSA and have existing NEPA documentation (e.g., BSL-3 contributions). If these planned operations are implemented in the future, they could result in increased activity above present levels. Under the No Action Alternative, the level of activity would increase RHWM operations as defined in Section 5.1.13.2, that would implement current management plans for assigned programs such as RCRA closure of Building 514. The No Action Alternative analysis includes any approved and interim actions and facility expansion, construction or management plans, where detailed design and associated permit documentation were completed. The analysis

also includes new construction such as BSL-3, several upgrades, building modifications, and removal of structures totaling approximately 234,000 square feet.

Other plans used to prepare the description of the No Action Alternative include the site development plans for LLNL, Programmatic EISs, and Part B Permit modifications and guidance. Some documents have future projects included for planning purposes; others have been omitted because of schedule constraints or because the projects were not at the point of decisionmaking, or other reasons. The activities reflected in this alternative include planned increases in some LLNL operations and activities over previous years' levels.

Implementation of the No Action Alternative would not cause any major changes in the types of waste streams generated onsite. Waste generation levels for the foreseeable future at LLNL would remain essentially consistent with recent generation quantities experienced during 1993 through 2002. Annually, any increase would be consistent with increases from new operations and normal fluctuations as previously noted. Waste minimization and pollution prevention techniques would be expected to offset projected increases. Onsite waste handling capacities are four to five times expected waste volumes. Waste projections used for analysis would not exceed existing offsite waste management disposal capacities. Wastes associated with existing operations, new operations, and special operations are presented below, including other wastes. The No Action Alternative would include several new operations, D&D projects, and other activities, including permit modifications and RCRA closures. Appendix B provides additional details on waste management activities under each of the alternatives. The No Action Alternative would include the following:

- Generation of routine waste quantities presented in Table 5.2.13.2–1
- Generation of nonroutine waste quantities presented in Table 5.2.13.2–1
- Generation of wastes associated with new operations presented in Table 5.2.13.2–2
- Recently approved and ongoing permit modifications

No additional waste storage, treatment, handling capacity, regulatory requirements, or security requirements would be needed.

Existing Operations

For projection purposes, routine waste generation data for 1993 through 2002 were considered a reasonable range for existing facilities/ operations; an average of these years was used. The amount of waste generated from existing operations anticipated would reflect proportional increases in LLNL activity levels over the foreseeable future. The waste quantities projected represent a site-wide aggregate of quantities for each type of waste category. Table 5.2.13.2–1 presents existing operations estimated annual (routine) waste generation quantities by waste category.

TABLE 5.2.13.2–1.—Routine and Nonroutine Operations Waste Generation Quantities Under the No Action Alternative and Existing Conditions

Waste Type	Annual Quantities			
	Existing Conditions ^a		No Action Alternative ^b	
	Routine	Nonroutine	Routine	Nonroutine
LLW	170 m ³ /yr	480 m ³ /yr	200 m ³ /yr	630 m ³ /yr
MLLW	67 m ³ /yr	44 m ³ /yr	61 m ³ /yr	72 m ³ /yr
Total Hazardous ^c	440 metric tons	880 metric tons	390 metric tons	1,500 metric tons
TRU	35 m ³ /yr	4.2 m ³ /yr	50 m ³ /yr	55 m ³ /yr
Mixed TRU	2.6 m ³ /yr	0 m ³ /yr	1.7 m ³ /yr	0 m ³ /yr
Sanitary solid	4,700 metric tons	Included in Routine	4,800 metric tons	Included in Routine
Wastewater	300,000 gal/day	Included in Routine	310,000 gal/day	Included in Routine

Source: DOE 2002s, LLNL 2002o, LLNL 2002x.

^a Based on average quantities since 1992 and one standard deviation.

^b For routine wastes based on average quantities since 1992 and one standard deviation, expected increase in activity levels, and new operations contributions. No margin was added for nonroutine.

^c Total hazardous includes RCRA hazardous, state regulated, and *Toxic Substances Control Act*.

gal/day=gallons per day; m³/yr= cubic meters per year; LLW = low-level waste; MLLW = mixed low-level waste; RCRA = *Resource Conservation and Recovery Act*; TRU = transuranic.

New Operations

New operations wastes, including project-specific information, are considered to be derived from mission-related work. The waste, quantities projected represent a site-wide aggregate of quantities for each type of waste category. Table 5.2.13.2–1 includes new operations and additions to the estimated annual (routine) waste generation quantities by waste category. Table 5.2.13.2–2 presents qualitative and quantitative waste information by project.

Special (Nonroutine) Operations

Special (nonroutine) wastes result from special, limited duration construction projects such as those considered separate from facility operations. Special, limited duration project wastes include those generated from construction, demolition, D&D, and environmental restoration. The amount of waste generated is anticipated to reflect proportional increases in LLNL activity levels over the next 10 years. The waste quantities projected represent a site-wide aggregate of quantities for each type of waste category. Table 5.2.13.2–1 presents estimated annual (nonroutine) waste generation quantities by waste category.

All Other Wastes

LLNL operations would also involve the five additional waste management activity areas discussed below under the No Action Alternative.

Biohazardous (includes Medical Waste Management Act) Waste

In 2002, several hundred kilograms of biohazardous wastes were disposed of at an approved offsite facility. Under the No Action Alternative, biohazardous waste generation would increase by 3 percent. The existing waste handling capabilities would be adequate to accommodate this waste. Offsite disposal capacity would continue to be sufficient.

Construction and Decontamination and Decommissioning Waste

To bound impacts, this analysis assumed the construction of 100,000 to 200,000 square feet of new facilities, including specific projects listed in Table 5.2.13.2–2. This would generate 200 to 400 metric tons of construction debris. Approximately two-thirds of wood, concrete, asphalt, soil, metal, and cardboard would be diverted for recycling or reuse (LLNL 2002cc). The existing waste handling capabilities would be adequate to accommodate the remaining waste. Offsite disposal capacity would continue to be sufficient.

Assuming all 255,000 square feet of excess facilities would be removed to bound impacts, D&D would generate approximately 1,530 metric tons of debris, 600 metric tons per 100,000 square feet. Only 350 metric tons would be LLW, MLLW, and hazardous waste. Approximately two-thirds of the debris would be diverted, recycled, or reclaimed (LLNL 2002cc). The existing waste handling capabilities would be adequate to accommodate this waste. Offsite disposal capacity would continue to be sufficient.

Environmental Restoration Waste

Site-wide environmental restoration waste generation trends at LLNL would generally remain a function of treatment units, the number of wells, and the number of hours of operation. Existing waste handling capabilities are already in place.

Explosive Wastes

The Explosive Waste Treatment Facility would handle 2,500 to 3,300 pounds per year. The Explosive Waste Storage Facility would store 5,500 to 6,500 pounds (gross) per year. This represents a 3 percent increase over existing conditions. No additional capacity would be required.

Wastewater

Wastewater would increase to approximately 310,000 gallons per day. The current capacity of 1.69 million gallons per day would be adequate to accommodate this waste. Offsite disposal capacity would continue to be sufficient.

Cumulative Impacts

The ROI for waste management involves LLNL and its facilities as presented in Chapter 4 of this LLNL SW/SPEIS.

The ROI for cumulative impacts is larger than that presented in Chapter 4 and considers the contributions of LLNL (Livermore Site and Site 300), SNL/CA, NNSA activities, local projects and activities, and the State of California. The NNSA assessed cumulative impacts by combining the potential effects of the Proposed Action with the effects of other past, present, and reasonably foreseeable activities in the ROI. The Proposed Action was chosen to assess and present a bounding scenario of potential cumulative effects. This approach allowed a conservative analysis for a maximum estimation of cumulative impacts.

5.2.14 Human Health and Safety

5.2.14.1 Nonradiological Health Impacts

Operations at LLNL involve a wide range of activities that have the potential for exposure of involved and noninvolved workers to hazardous materials or conditions. These hazards include non-ionizing radiation, chemicals, biological agents, and industrial hazards. Evaluation of occupational protection issues considered existing ES&H programs that specifically address worker and general population protection measures implemented to control, reduce, or eliminate operational hazards. Appendix C presents a detailed description of LLNL ES&H programs implemented to monitor and ensure that all sectors of the local environment are protected. Hazardous chemicals to which involved and noninvolved workers could be potentially exposed, under the No Action Alternative, at the Livermore Site and Site 300, are listed in Tables 5.2.13.1–1 and 5.2.13.1–2.

Relationship with Site Operations

Section 3.2 describes projects under the No Action Alternative. When combined with current operations, these projects would result in small increases in chemical inventories. There would also be an increase in construction and demolition activities associated with site facility expansion and renovation due to new missions and facility demolition and removal activities. These activities would represent an increase in potential injuries associated with construction safety hazards.

Impact Analysis

Under the No Action Alternative, major changes in the types of occupational, toxic, or physical hazards encountered by site personnel would not be expected. Under the No Action Alternative, an approximate 3 percent site-wide increase in average chemical inventories would be expected. Under this alternative, 11 construction projects, 7 D&D projects, 6 renovation projects, and 4 new operations would begin. Site material usage would be expected to increase slightly as a result of the four new operations. However, as the mix of site missions shifts from chemical to mechanical processes, the proportional increase in chemical inventories associated with new operations would be lessened.

During the course of routine operations, the potential exists for some personnel to be exposed to chemical, biological, and physical hazards. The LLNL Integrated Safety Management System (ISMS) minimizes the occurrence and mitigates the consequences of these exposures by identifying and analyzing potential hazards during the planning stages of work activities. Site workers conduct work in accordance with established site-wide programs as well as project-specific programs. Site-specific integration work sheets, facility safety plans, and standard operating procedures are prepared to supplement activities not covered by site safety plans or the LLNL ES&H Manual (LLNL 2000i). As hazards are identified, appropriate control measures are developed for implementation during the performance of work. Workplace monitoring provides data for the characterization of hazards and provides information on personnel exposures (LLNL 2003k). Personnel exposure monitoring data for 2001 indicating the potential for personnel exposures are presented in Appendix C.

Overall site usage of toxic substances and physical hazards would increase under the No Action Alternative as activity levels increase at existing facilities and as new facilities are constructed and begin operation. However, this would not represent an adverse impact. Under the No Action Alternative, the use of additional quantities of chemicals would result in a slight increase in worker exposures. Facility improvements and additions would result in improved control measures for handling hazardous chemicals and controlling physical hazards. Worker exposure to hazardous chemicals would be minimized by the use of improved facilities for handling toxic chemicals and controlling physical hazards. Continued application of site ES&H and ISMS principles would result in minimal impacts to workers and the public.

Tables 4.15.1.2–3 and 4.15.1.2–4 summarize the maximum and average quantities of hazardous chemicals stored at LLNL facilities. At the Livermore Site, the FY2001 chemical inventory indicated average quantities to be 60,902 gallons of liquids, 1.4 million pounds of solids/gases, and 19.4 million cubic feet of compressed gases. Under the No Action Alternative, these quantities would increase by 9,700 gallons and 29,000 pounds, and would decrease by 8.86 million cubic feet, respectively. Projected maximum and average quantities of hazardous chemicals stored at the Livermore Site and Site 300 for the No Action Alternative are presented in Tables 5.2.13.1–1 and 5.2.13.1–2. The corresponding FY2002 quantities for Site 300 are 56,000 gallons of liquids, 42,000 pounds of solids/gases, and 387,000 cubic feet of compressed gases, which would increase by 300 gallons, 1,300 pounds, and 6,100 cubic feet, respectively (TtNUS 2003). Physical hazards such as noise, electrical shock, and workplace injuries/illnesses could also increase under the No Action Alternative.

Employees at Site 300 conduct work in accordance with established site-wide ISMS programs as well as Site 300-specific programs. Site-specific integration work sheets, facility safety plans, and standard operating procedures are prepared to supplement activities not covered by site safety plans or the LLNL ES&H Manual (LLNL 2000i). The No Action Alternative projects are assumed to result in an approximate 3 percent increase in usage of hazardous chemicals. However, this would not increase worker exposure because these projects would include improved facilities for handling toxic chemicals and controlling physical hazards.

Based on the assumption that the increase in the facility footprint associated with the No Action Alternative represents an increase in chemical inventory, worker exposures would slightly increase.

Using the 2001 personnel exposure data, due to the downward trend, the following results would be expected for the peak workforce year during the 10-year period ending in 2014:

- 330 measurable results out of 1,391 analyses from personnel sampling
- 33 results in excess of OSHA Permit Limit Exposure (PEL) or American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLV), not corrected for respiratory protection

Corrected for the use of respiratory protection, no personnel exposures above DOE action levels, OSHA PELs, or ACGIH TLV would be expected.

Site injury and illness data for the 7-year period ending in 2002 indicate a decrease from 1996 levels; i.e., recordable case rate of 6.9 in 1996 versus 3.0 in 2002. A slight increase in recordable case rates occurred in 1997 and 1998; in 2000, lost/restricted workday case rates were higher than 1999, 2001, and 2002. Additional information is presented in Appendix C. Using the 2002 injury and illness data as bounding, due to the downward trend, the following results would be expected for the reasonably foreseeable workforce year under the No Action Alternative.

- 237 recordable cases
- 71 lost or restricted workday cases
- No fatalities would be expected

The overall decrease from 1996 to 2002 demonstrates the effectiveness of the ES&H program (LLNL 2002ck, LLNL 2003u). This success is also due in part to the implementation of the ISMS. Although an increase in construction, demolition, and renovation activities would occur under the No Action Alternative, these activities would not have a significant impact onsite injury and illness rates.

Facility upgrades and continued implementation of site ES&H program components would significantly reduce the risk of personnel exposures. Workplace and personnel monitoring data indicate the effectiveness of the current program (LLNL 2002bk). Several proposed projects would increase levels of protection for both workers and the general public. These include the Building 151 Upgrade, Building 331 renovation and modification, and Building 332 ductwork replacement.

Ongoing and planned D&D activities would reduce overall site hazards by removing chemical and physical hazards from the workplace. Facilities to undergo D&D would include the U235 cooling tower and Building 514.

The planned infrastructure improvements, such as roof replacements, facility renovations and facility and system upgrades, would improve the overall safety. The planned structural and seismic upgrades would result in improved facilities and work areas. Facility roof replacement would provide protective measures for sensitive facility components and increase the protection of potentially hazardous areas from exposure to the environment. Electrical and ventilation upgrades would increase facility control features and reduce the risk of hazardous energy events. Therefore, the overall impact of these activities would be beneficial. Assuming the improved safety system in Building 514 reduces accidents, this could result in a reduction of impacts.

Cumulative Impacts

The occupational health and safety of workers at LLNL is site-specific and would not be affected by other activities occurring within the area. Cumulative effects for workers would be the same as those presented above in the No Action Alternative impact analysis.

5.2.14.2 Radiological Health Impacts

This section analyzes the No Action Alternative radiological health impacts from ongoing operations (e.g., R&D, waste management) and facilities under construction (e.g., the NIF). Impacts to workers are given in terms of number of cancer fatalities resulting from employment activities in the worker population. No Action Alternative radiological health impacts to the public from normal releases for the same operations are also described. These impacts are given in terms of the probability of the site-wide MEI contracting a fatal cancer from these operations. The number of fatal cancers expected in the general population from LLNL operations is also described.

Relationship With Site Operations

This section summarizes the relationship between projects described in Section 3.2 for the No Action Alternative and radiological health impacts from normal site operations. The No Action Alternative dose will increase as new and increased operations come on line. The maximum doses and health effects over this timeframe are presented here. The number of cancer fatalities to workers and the general public from exposure to these operations is used to quantify the impacts.

Impact Analysis

Workers

The dose to involved workers, i.e., workers who are directly exposed to radiation in the performance of their jobs, would be approximately 89 person-rem per year. This dose includes approximately 15 person-rem per year from the NIF. Most of the remainder of this dose would be from operations in Building 332. Workers would be exposed to an increased risk of cancer as a result of occupational exposure to radiation over an extended period (calculated value of 0.053 fatalities per year of operation). Note that radiation exposure in all radiologically controlled areas are kept as low as reasonably achievable (ALARA) through facility and equipment design and administrative controls.

The dose to noninvolved workers, i.e., exposure to normal site radiological emissions not directly related to performance of their jobs, would be approximately 0.14 person-rem per year (see Section 5.2.8.2). Over 95 percent of this dose is from Livermore Site operations. No cancers (calculated values of 8.4×10^{-5} LCFs per year of operation) are expected among noninvolved workers.

General Public

The No Action Alternative health impacts to the hypothetical offsite site-wide MEI at the Livermore Site and Site 300 are calculated from the radiation dose described in Section 5.2.8.2 (emissions to the atmosphere) plus the radiation dose from neutrons penetrating the roof of the NIF. This is described in Appendix M of this LLNL SW/SPEIS. The dose to the public from LLNL air emissions would be due to exposure, either directly from the plume or through deposition and subsequent inhalation and ingestion. The dose to the site-wide MEI from neutrons

produced at the NIF is a result of exposure to these neutrons (and the gamma rays produced) after they collide with the molecules in the air and scatter to the ground (skyshine).

The No Action Alternative dose to the Livermore Site site-wide MEI would be 0.30 millirem per year (0.10 from air effluents, mainly tritium, and 0.2 from skyshine). Such doses are limited by DOE O 5400.5, “Radiation Protection of the Public and the Environment.” This order limits doses caused by all pathways of release of radiation or radioactive material to 100 millirem per year for prolonged exposure (DOE O 5400.5). The probability of a LCF to the site-wide MEI would be 1.8×10^{-7} per year of exposure. The No Action Alternative site-wide MEI dose from Site 300 operations would be 0.055 millirem per year, less than 0.6 percent of the NESHAP standard. The probability of a LCF to this hypothetical individual would be 3.3×10^{-8} per year of exposure.

The population dose from all LLNL operations would be 11.6 person-rem per year. The skyshine dose from the NIF is not included in the population dose estimate; skyshine is important near the Livermore Site boundary to a hypothetical individual continuously located at the site boundary (i.e., the site-wide MEI). It is less important to the general population whose exposure to it would be either transitory or nonexistent. Approximately 0.007 LCFs to the public would result annually from exposure to Livermore Site operations.

Cumulative Impacts

There is a possibility that an individual worker would contract a fatal cancer sometime during that worker’s lifetime as a result of occupational exposure under the No Action Alternative (calculated value of 0.054 fatalities per year of operation).

No adverse impacts to the general population would occur under the No Action Alternative. Other than background radiation sources, there are no other known contributors to concentrations of radionuclides near the Livermore Site or Site 300. Therefore, there would be no cumulative radiological impacts.

5.2.15 Site Contamination

The following section analyzes impacts to contaminated soils and sediments, and groundwater under the No Action Alternative. For the purpose of this LLNL SW/SPEIS, soils and sediments discussed below include surficial soils, both unconsolidated and consolidated sediments, and unsaturated bedrock.

5.2.15.1 Relationship with Site Operations

This section summarizes the relationship between projects described in Section 3.2 under the No Action Alternative and the site contamination impact analysis.

Soil and groundwater contamination at LLNL occurred as the result of past operations and could be occurring from ongoing operations in outdoor testing areas, handling and storage of hazardous materials, waste management activities, and radioactive material management activities. At the Livermore Site, selected remedial actions are expected to be in place by the end of FY2006. The remediation of VOCs will be conducted using soil vapor extraction. Contamination in the

unsaturated zone will be remediated only if it is predicted to impact groundwater above the maximum contaminant level (MCL). The cleanup of these soils is not expected to exceed predetermined, risk-based cleanup standards, but concentrations are still expected to exceed background levels. At Site 300, selected remedial actions are expected to be in place by the end of FY2008.

NNSA is concerned with deposition of contaminants on the ground surface during normal operations or accidents. The more frequently activities are undertaken, the greater the probability of an occurrence that results in soil contamination. The No Action Alternative would increase the likelihood of soil contamination over the existing conditions. A 3 percent increase in activity levels across the site is projected; accordingly, an increase in hazardous material management and waste management, and an associated spill or release could occur. LLNL would continue to conduct immediate cleanup actions and periodic site surveys to ensure environmental impacts are minimized.

Chemical, oil, or hazardous material spills or releases would be possible given the variety of materials handled at LLNL. Although substantial quantities of hazardous materials are not present on LLNL, some buildings use a variety of chemicals, acids, bases, solvents, and other hazardous materials. The radioactive and hazardous waste management facilities store and handle hazardous and radioactive wastes being prepared for onsite treatment and shipment offsite for disposal. These facilities are the onsite receiving point for all chemical wastes and have the potential for hazardous spills, releases, or fires. Additionally, most of the onsite research laboratories use small amounts of chemicals for research projects. At LLNL, controls are in place to minimize the potential for soil contamination from any LLNL operations.

5.2.15.2 *Impact Analysis*

As of the end of 2002, 1.9 billion gallons of groundwater have been treated at the Livermore Site (LLNL 2003I). Offsite contamination is being effectively cleaned up and plume sizes are decreasing. A total of 104 of the 120 release sites are in long-term stewardship. Of the remaining sites, further cleanup is ongoing.

By the end of FY2006, NNSA plans to have in place remediation facilities at all currently identified sites scheduled for long-term stewardship, in some cases 50 to 60 years. Cleanup activities scheduled for the Livermore Site during the next 5 years are listed in Chapter 4, Section 4.17.1.3.

As of the end of 2002, 236 million gallons of groundwater have been treated at Site 300 (LLNL 2003I). Offsite contamination has been effectively remediated and contaminant concentrations in source areas are being reduced. A total of 53 of the 73 release sites have completed assessment and remedial action phases are designated for long-term stewardship (DOE 2001b). Of the remaining sites, further investigation and remediation are ongoing.

By the end of FY2008, NNSA plans to have in place remediation facilities at all currently identified sites scheduled for long-term stewardship of contaminated areas, in some cases, 60 to 70 years. Cleanup activities scheduled for Site 300 during the next 5 years are listed in Chapter 4, Section 4.17.2.3.

The No Action Alternative would increase the likelihood of soil contamination over the existing conditions; however, minimal deposition of contaminants from continued operations to soil and continued removal of known contaminants under the cleanup effort would occur. No adverse impacts to future designated land use would be expected. No further adverse impacts on groundwater would be expected. Under the No Action Alternative, continued improvement of water quality and source reduction would occur at both the Livermore Site and Site 300 due to operation of existing remediation facilities, construction of planned remediation facilities, and natural attenuation of contamination already in soils and groundwater.

5.2.15.3 Cumulative Impacts

The ROI for site contamination involves LLNL and its remedial sites as presented in Chapter 4 of this LLNL SW/SPEIS. The ROI for analysis of cumulative impacts is larger than that presented in Chapter 4 and considers the contributions of LLNL (Livermore Site and Site 300) and local projects to contamination of nearby groundwater resources. Cumulative impacts could result either from LLNL groundwater contamination commingling with other plumes causing exceedance of water quality criteria in the combined plume, or from a limitation of aquifer/land usability as the volume or areal extent of contaminated groundwater/soil makes the aquifer/land substantially less suitable for its designated purposes.

Sandia National Laboratories/California

SNL/CA Environmental Restoration Program activities began in 1984. By 1991, 23 solid waste management units were identified. Of these locations, nine were identified for further investigation. The largest site, the Navy Landfill, is 2 acres. Investigation of these sites is regulated under RCRA. As of February 2002, environmental restoration activities at SNL/CA had progressed through a series of remedial and closure actions to the point where most sites have attained closure and active environmental monitoring is continuing on three sites: Fuel Oil Spill, Navy Landfill, and the Trudell Auto Repair Shop site. SNL/CA is working with the State of California on full closure requests and monitoring requirements.

Five non-Federal contaminated sites are located in the city of Livermore, none of which are listed on the National Priorities List. Two sites (one Federal) are located in the city of Tracy. The Federal Defense Distribution Center of San Joaquin is on the National Priorities List.

Past, present, and planned activities are designed to minimize contamination at LLNL, SNL/CA, and other sites. The cleanup of these sites has been and will be performed to a level that meets State of California's approved health risk based standards, which vary depending on the contaminants of concern, corresponding to the intended future uses of the sites. As existing contamination at LLNL is being cleaned up under the Environmental Restoration Program, no cumulative impacts would be expected.

5.3 IMPACTS FOR THE PROPOSED ACTION

This section discusses the potential environmental consequences of the Proposed Action. The Proposed Action for this LLNL SW/SPEIS is the continued operation of LLNL, including near-term (5 to 10 years) proposed projects, as well as those projects, activities, and facilities described in the No Action Alternative. Chapter 3 and Appendix A of this document contain detailed descriptions of all projects included in the Proposed Action. The LLNL operations include the Livermore Site and Site 300.

5.3.1 Land Uses and Applicable Plans

This section describes the impacts to land uses and applicable plans under the Proposed Action. Impacts are analyzed for the Livermore Site and Site 300 based on the methodology presented in Section 5.1 of this chapter.

5.3.1.1 *Relationship with Site Operations*

This section summarizes the relationship between projects described in Chapter 3, Section 3.3, for the Proposed Action and the land use impact analysis. The primary effect on land uses at the Livermore Site would be from the additional development associated with projects requiring new buildings under the Proposed Action. However, existing perimeter open space areas would be retained.

At Site 300, the Proposed Action includes construction of new facilities and upgrading of several existing facilities, roadways, and utilities. Due to proposed D&D, there would be a decrease of the current developed gross square footage. No land acquisitions would be included as part of the Proposed Action. The types of land uses at Site 300 would not change, and the open space character of the site would be retained.

5.3.1.2 *Impact Analysis*

Livermore Site

Under the Proposed Action, facilities would be constructed (Figure 5.3.1.2–1), others would be upgraded, and a number of trailers would be relocated, replaced, or removed as the permanent facilities are completed (see Chapter 3 and Appendix A). These projects are in addition to those planned under the No Action Alternative. While the types of land uses at the Livermore Site would not change under the Proposed Action, some infill and modernization would occur. New facilities that would be located in the undeveloped portions of the Livermore Site are the same as those listed for the No Action Alternative (Table 5.2.1.2–1).

The land use effect would be extremely small because there would be only a small increase in the developed space at the site. New structures would be for the same uses as existing facilities, R&D, which is the existing land use designation for all Livermore Site facilities. Therefore, they would not represent a change in land uses, nor lead to a conflict with existing and approved future land uses adjacent to the site. Although the Livermore Site is on Federal land and not subject to local zoning ordinances, LLNL's R&D facility activities would be compatible with the MP designation (industrial park) in Alameda County and the I-2/I-3 designations (professional

and administrative offices/R&D facilities) in the city of Livermore (LLNL 2001r). The Proposed Action would result in additional development at the site to be used for the same types of uses as existing facilities. No changes in land ownership would occur and no new impacts to land use are expected.

New facilities at the site could have secondary effects due to increased personnel and activity at the site. These effects could include additional traffic, noise, vehicular exhaust emissions, demands for community services, increased consumption of natural resources, and increased waste generation. These potential effects are addressed in the applicable parts of Chapter 5 of this LLNL SW/SPEIS.

Site 300

The primary effect on land uses at Site 300 would be from the development of additional square footage associated with certain projects included under the Proposed Action. No major alteration in the types of land uses would result. The Proposed Action would result in additional development at the site for the same uses as existing facilities. No changes in land ownership would occur.

Site 300 is exempt from local plans, policies, and zoning regulations. However, it is NNSA and University of California policy to cooperate with local governmental planning agencies, in this case San Joaquin and Alameda counties and the city of Tracy, whenever possible. Land uses surrounding Site 300 include other explosives testing facilities, undeveloped open space, agricultural land, and an off-road vehicle recreation area (see Chapter 4, Section 4.2). The uses at Site 300 are compatible with the existing land uses and approved land use designations surrounding the site, and with open space policies regarding resources near the site. Because Proposed Action activities would represent a continuation of existing land uses, they would be compatible with existing and approved future land uses surrounding the site.

The Proposed Action would include upgrading several existing facilities, roadways, and utilities, and constructing the Energetic Material Processing Center (EMPC) and the High Explosives Development Center (HEDC). Chapter 3 and Appendix A provide more detailed descriptions of the Proposed Action. Because Site 300 is located on approximately 7,000 acres of largely undeveloped land and the proposed construction projects and upgrades would be dispersed throughout the site, they would not represent a substantial infill of land uses, and the existing character of the site would remain unaltered.

New structures would be for the same types of uses as existing facilities. Therefore, they would not represent a change in land uses, nor lead to a conflict with existing and approved future land uses adjacent to the site. As discussed in Section 4.3, land uses would be compatible with the existing land uses and open space policies of San Joaquin and Alameda counties.

Growth at the site could have secondary effects due to increased personnel and activity at the site, including additional traffic, noise, vehicular exhaust emissions, demands for community services, increased consumption of natural resources, increased waste generation, etc. These potential effects are addressed in the applicable parts of Chapter 5 of this LLNL SW/SPEIS. Thus, minimal impacts to land use are anticipated.

5.3.1.3 Cumulative Impacts

Livermore Site

The cumulative impact study area with regard to land uses and planning programs for the Livermore Site is defined as that area of Alameda County generally east of Tassajara Road in the city of Dublin, and Santa Rita Road in the city of Pleasanton, which encompasses the city of Livermore and eastern unincorporated Alameda County. Large undeveloped open space areas exist in the northern, eastern, and southern portions of Alameda County. The majority of the undeveloped areas are used for agricultural purposes, primarily for grazing and viticulture. Agricultural lands in the South Livermore Valley General Plan Amendment area support an active wine industry.

A continuing land use trend in Alameda County has been the encroachment of residential, commercial, and industrial uses upon agricultural and open space areas. Development of planned and proposed residential projects would contribute to the cumulative loss of agricultural land and open space. However, the Proposed Action would not directly contribute to the cumulative effect on the loss of agricultural land and open space because the Livermore Site is already committed to R&D land uses and no acquisition of open space or agricultural land is proposed.

Site 300

The cumulative impact study area with regard to land uses and planning programs for Site 300 is defined as that portion of San Joaquin County generally south of I-205 that encompasses the city of Tracy and southwestern unincorporated San Joaquin County. Land uses in the area south of I-580 in unincorporated San Joaquin County include agricultural (primarily grazing), commercial recreation, and explosives testing facilities (including Site 300).

The city of Tracy, the border of which is located approximately 2 miles northeast of Site 300, has a developed core of residential and commercial uses, which becomes less dense along the outer boundaries of the city. Industrial and agricultural land uses surround the developed part of the city. In 1998, the city of Tracy annexed the Tracy Hills area (6,175 acres) southwest of I-580, the area of Tracy that is now closest to Site 300. In an effort to preserve agricultural land on the valley floor, the City of Tracy Planning Department is encouraging new development in hillside areas, such as Tracy Hills (City of Tracy 1993).

A residential community such as Tracy Hills could be compatible with Site 300 depending on the final design and siting of residences. The city of Tracy also has annexed an area of San Joaquin County that is approximately 2 miles from Site 300 and has planned for residential development in this area. The Tracy General Plan provides for a conservation, or open space, area to be established that would be a buffer zone between Site 300 and any potential new development.

5.3.2 Socioeconomic Characteristics and Environmental Justice

This section analyzes the socioeconomic impacts associated with implementation of the Proposed Action. This analysis is organized by employment, and housing and population, with effects delineated by geographic area (counties and cities within the ROI). Environmental justice issues are also discussed.

5.3.2.1 Relationship with Site Operations

This section summarizes the relationship between projects described in Section 3.3 under the Proposed Action and the socioeconomic impact analysis. In general, the effect of projects under the Proposed Action on socioeconomics would be limited to the additional employment opportunities provided because of design, construction, and operation of these projects, as described below, and the effects of the additional secondary or indirect employment opportunities. Projected staffing changes are shown in Table 5.3.2.1–1.

TABLE 5.3.2.1–1.—Input Parameters for Socioeconomic Analysis Under the Proposed Action

Parameter	Units	Site	No Action Alternative	Proposed Action
Employment	Number of personnel	LLNL	10,650 (all site workers)	11,150 (all site workers)
		Livermore Site	8,900 (LLNL employees) 17,500 (LLNL employees and indirect)	9,410 (LLNL employees) 18,500 (LLNL employees and indirect)
		Site 300	250 (LLNL employees) 490 (LLNL employees and indirect)	250 (LLNL employees) 490 (LLNL employees and indirect)
Expenditures	Dollars (2001)	LLNL	146 M (Bay Area)	153 M (Bay Area)
Payroll	Dollars (2002)	LLNL	690 M (LLNL employees) 1,130 M (direct and indirect)	729 M (LLNL employees) 1,200 M (direct and indirect)

LLNL = Lawrence Livermore National Laboratory; M = million.

5.3.2.2 Impact Analysis

LLNL jobs and expenditures generate indirect jobs in the region. The RIMS II economic model produces two multipliers that are useful for the evaluation of economic effects (BEA 2003). The first multiplier is used to calculate worker earnings, and the second calculates employment. These multipliers provide information needed to estimate LLNL's economic impact. Earnings and employment multipliers make possible the identification of not only the direct impacts of an activity on regional income and jobs, but also the indirect effects.

Under the Proposed Action, LLNL employment at the Livermore Site would increase by approximately 500 above the No Action Alternative to 9,410. This increase, multiplied by a factor of 1.97, would increase employment by approximately 1,000 within the four-county ROI. LLNL payroll would increase by \$39 million above the No Action Alternative. This increase multiplied by a factor of 1.64 would generate approximately \$64 million of overall economic effect within the ROI. Therefore, the Proposed Action would generate additional revenue from increased purchases of goods and services, and create additional increases in population and subsequent increases in housing demand. The employment projections are conservatively high for purposes of evaluating reasonably foreseeable socioeconomic impacts associated with employment growth.

Based on the FY2002 LLNL payroll of \$668 million, the regional earnings multiplier of 1.64 yields an overall economic effect of \$1.096 billion within the ROI. Based on the total LLNL

direct employment and the regional employment multiplier of 1.97, an estimated total of 17,400 jobs in the ROI are attributable to LLNL. In effect, one out of every 95 jobs (or 17,400 out of 1,644,500) in the ROI is directly or indirectly attributable to LLNL.

Under the Proposed Action, Site 300 total employment would remain at approximately 250 as projected for the No Action Alternative. There would be no additional socioeconomic impacts under the Proposed Action for Site 300 beyond those described for the No Action Alternative in Section 5.2.2. Therefore, socioeconomic impacts specific to Site 300 are not addressed in this section.

Employment and Expenditures

Region

The Proposed Action would provide additional employment opportunities in the region and would increase the payroll at LLNL. Assuming approximately a 500-employee increase in payroll and pay rates proportional with 2002 salaries, the additional annual payroll generated by the Proposed Action would be \$39 million higher than the No Action Alternative in 2002 dollars. A portion of this increased payroll would enter the local economy as the new workers purchase additional goods and services. The combined direct and indirect effects of increased employment would result in an employment increase of approximately 1,000 within the region. Likewise, the direct and indirect effect of payroll expenditures would result in a \$70 million increase to the regional economy.

In addition, the Proposed Action would result in an increase in expenditures by LLNL. Additional goods and services would be required to support the additional activities, facilities, and workers required by the Proposed Action.

Spending by both the additional LLNL personnel and the LLNL increased activity would generate additional revenue and employment opportunities within the ROI as monies filter throughout the economy. The additional income and employment opportunities generated by the Proposed Action would represent a beneficial economic impact to the region.

Alameda County

Total employment in Alameda County was estimated at 751,680 in 2000 (Association of Bay Area Governments 2001). The Proposed Action would generate approximately 500 more jobs at the Livermore Site than the No Action Alternative. Employment projections for the county estimate employment opportunities would increase 14.1 percent to 857,450 by the year 2010 (Association of Bay Area Governments 2001). The additional jobs created by the Proposed Action at LLNL would represent 0.5 percent of the projected increase in employment within the county. This increase in employment, less than a 0.1 percent increase over the 2000 county employment level, would have a minimal impact to the county.

Population and Housing

For this analysis, increases in population level and housing demand from the Proposed Action are projected to be conservatively high in order to determine the maximum expected impact. It

was assumed that someone outside of the project region would fill each new job, that all new LLNL workers (including LLNL employees, contractors, and Federal employees) would migrate to the region, and that each worker would represent a new household. In reality, a percentage of new workers would already reside in the project region, and some households would shelter more than one employee. While this method overestimates migration of new workers to the project region, it also allows for the backfilling of vacancies left as some workers leave their current jobs in the region to work at LLNL. The geographic distribution of future LLNL workers would be similar to the 2002 distribution of employee residences (Table 5.3.2.2–1).

TABLE 5.3.2.2–1.—Anticipated Geographic Distribution of Lawrence Livermore National Laboratory Worker Residences Under the Proposed Action

City	Percent of LLNL Workers ^{a,b}	Additional New Workers Projected to Reside in City under No Action Alternative ^c
Alameda County		
Livermore	37.0	185
Pleasanton	6.2	31
Castro Valley	4.0	20
Dublin	2.1	11
Oakland	2.1	11
Other Alameda County	4.1	21
Total	55.5	279
San Joaquin County		
Tracy	8.2	41
Manteca	4.8	24
Stockton	2.6	13
Other San Joaquin County	2.9	14
Total	18.5	92
Contra Costa County		
Brentwood	2.7	14
San Ramon	2.7	14
Other Contra Costa County	7.4	37
Total	12.8	65
Stanislaus County		
Modesto	3.2	16
Other Stanislaus County	2.9	14
Total	6.1	30
Counties Outside the ROI		
Total	7.2	36

Source: LLNL 2003ak.

^a Distribution as of September 30, 2002.

^b May not total 100 because figures are rounded off.

^c Calculated based on 500-employee increase. May not total 500 because of rounding.

ROI = region of influence.

Alameda County

Based on the anticipated geographic distribution of personnel residences (Table 5.3.2.2–1), the Proposed Action would result in an in-migration of 279 more workers to Alameda County over the next 10 years than under the No Action Alternative. This represents 56 percent of new LLNL personnel. Assuming 2.74 persons per household for the county (Census 2003), the population associated with the additional workforce migrating into the county would be 764 persons more than the No Action Alternative. This represents less than 0.1 percent of the 2001 population within the county. The county population is projected to increase 16.8 percent from 2001 to 2010 (Association of Bay Area Governments 2001, Census 2003). The incremental population increase associated with the Proposed Action would be within population growth projections for the county.

Assuming one worker per household, housing demand generated by the additional workforce would be 279 more dwelling units over 10 years than under the No Action Alternative, raising the total number of housing units occupied by LLNL workers to approximately 6,327 within Alameda County. In 2002, Alameda County had 546,735 housing units. The vacancy rate in the county was 3.0 percent, an estimated 16,620 available units (DOF 2002). Demand for housing associated with LLNL's additional personnel under the Proposed Action would be 1.7 percent of the unoccupied housing in 2001 within the county. Minimal impacts on housing in Alameda County are expected.

City of Livermore

As shown in Table 5.3.2.2–1, the majority of new LLNL workers (37 percent, or 185 more than the No Action Alternative) are projected to reside in Livermore, based on the 2002 pattern of employee residence location. Using the year 2000 person per household figure of 2.81 for the city of Livermore (Census 2002b), and assuming one worker per household, the population increase associated with the workforce migrating into the city would be 520 persons. This represents a 0.7 percent increase over the city of Livermore's 2000 population. The city's population is projected to increase by 23 percent from the year 2000 to 2010 (Association of Bay Area Governments 2001).

Assuming each new worker migrating into the city creates a demand for one additional housing unit, 185 units more than the No Action Alternative over 10 years would be required under the Proposed Action. In 2000, the city had a housing supply of 26,610 units, and a vacancy rate of 1.8 percent (Census 2002b). This represents 487 available housing units. The current city of Livermore Housing Implementation Program, covering the 3-year period 2002 through 2004, limits housing unit growth to a maximum of 1.5 percent per year (City of Livermore 2001). Assuming an annual growth rate of 1.5 percent, 5,363 new housing units would be available by the year 2014. The demand for housing associated with new employees needed under the Proposed Action would represent 3.4 percent of the projected number of new housing units, and 0.6 percent of the total projected housing stock. Population growth under the Proposed Action could be accommodated in the current housing market and housing growth is projected to continue; minimal impacts are anticipated.

City of Pleasanton

Under the Proposed Action, 31 more new workers employed would reside in Pleasanton, based on the existing geographic distribution of personnel (Table 5.3.2.2–1). Using the year 2000 person per household figure of 2.73 (Census 2002b), the city of Pleasanton population increase associated with new personnel would be 85 persons more than the No Action Alternative. This represents a 0.1 percent increase over the 2000 population of 63,654. This population increase would be within the 22 percent population growth estimate by the year 2010 as projected by the local planning unit (Association of Bay Area Governments 2001).

Housing demand generated by new workers because of the Proposed Action would be 31 housing units more than the No Action Alternative over 10 years, assuming one household per new employee. The year 2000 housing supply within the city was 23,968 units, with a vacancy rate of 2.7 percent (Census 2002b). This represents an available supply of 657 units. The demand for housing units associated with new workers would represent 4.7 percent of the number of available units in the year 2000. In addition, local planning governments project an 18 percent increase in the supply of housing by 2010 (Association of Bay Area Governments 2001). Because population growth under the Proposed Action could be accommodated in the current housing market and housing growth is projected to continue, minimal impacts are anticipated.

San Joaquin County

Under the Proposed Action, based on the anticipated geographic distribution of personnel, 92 more of the new workers would reside within San Joaquin County than under the No Action Alternative (Table 5.3.2.2–1). Based on the person per household figure of 3.17 (Census 2003), the San Joaquin County population increase associated with the new employees would be 292 persons. This represents less than 0.1 percent of the total 2001 population within the county. San Joaquin County's population projection is 727,800 by the year 2010, a 26.2 percent increase (DOF 2001). The incremental population increase associated with the Proposed Action would be accommodated within county growth projections.

Housing demand generated by new workers, assuming one worker per household, in the county would be 92 units over 10 years, raising the total number of housing units occupied by LLNL workers to approximately 2,109 within San Joaquin County. Housing supply within the county for the year 2002 was 197,279 units, with a vacancy rate of 3.9 percent (DOF 2002). The total number of vacant units was 7,767. The county projects a 26 percent increase in the number of housing units by the year 2010 (SJCOG 2000). Because the demand generated by the project would be small relative to the number of available and planned units, minimal impacts are anticipated.

City of Tracy

Based on the anticipated geographic distribution of new personnel under the Proposed Action, 41 more new workers would choose to live in the city of Tracy over 10 years than under the No Action Alternative. Based on the person per household figure of 3.23 (Census 2002a), the city of Tracy population increase associated with the Proposed Action would be 132 persons. This represents 0.2 percent of the 2000 population.

Housing demand within the city of Tracy due to Proposed Action implementation would be an additional 41 dwelling units over the No Action Alternative. The housing supply within the city in 2000 was 18,087 units (Census 2002a). In 2000, the vacancy rate for the city was 2.7 percent, which represents 467 available units. The demand generated by the new workers would represent 8.8 percent of the year 2000 supply of available housing. In addition, the number of housing units in the city is projected to increase 38 percent by the year 2010 (SJCOG 2000). Thus, under the Proposed Action, the housing demand could be accommodated in the current and projected housing supply, and minimal impacts are anticipated.

Environmental Justice

In general, LLNL operations under the Proposed Action would have no anticipated disproportionately high and adverse health or environmental impacts on low-income or minority populations. Effects would be qualitatively equivalent to those described for the No Action Alternative in Section 5.2.3.2. A number of quantitative differences exist between the data presented in Section 5.2.3.2 and the Proposed Action:

- As indicated earlier in this section, 11,150 workers would be required at the Livermore Site, 500 more than under the No Action Alternative.
- As presented in Section 5.3.3, an estimated 4,900 metric tons per year of nonhazardous solid waste would be generated at the Livermore Site for disposal, 300 metric tons per year more than under the No Action Alternative.
- As presented in Section 5.3.8, the MEI dose from radiological air emissions at the Livermore Site would be 0.13 millirem per year, higher than the No Action Alternative estimate of 0.098 millirem per year.
- As discussed in Section 5.3.11, the collective radiation dose to the population along the transportation route is calculated at 9.0 person-rem per year with 0.005 LCFs per year, higher than the No Action Alternative estimates of 7.4 person-rem per year and 0.004 LCFs per year.
- As presented in Section 5.3.12, the projected peak electrical demand at LLNL would be 81 megawatts with an annual use of 442 million kilowatt-hours, compared with 82 megawatts and 446 million kilowatt-hours.
- As presented in Section 5.3.14, worker dose to ionizing radiation would be 93 person-rem per year, higher than the 90 person-rem per year under the No Action Alternative.

None of these changes would result in disproportionately high and adverse impacts on low-income or minority populations under the Proposed Action.

5.3.2.3 Cumulative Impacts

Approximately 380 more new LLNL workers would elect to live in the various communities listed in Table 5.3.2.2–1 under the Proposed Action than the No Action Alternative, in the same proportion that existing workers have selected communities for their residences. In addition,

approximately 120 workers and their families would be distributed throughout other communities in the Bay Area and central San Joaquin Valley. The Proposed Action would contribute to the cumulative demand for housing in the region associated with new employment opportunities. However, because vacancy rates are high enough to accommodate the demands of new employees for housing in the city of Livermore, the community with the highest current and anticipated concentration of LLNL employees, it is assumed that other parts of the region could also meet the housing demand created by the increase in local job opportunities.

5.3.3 Community Services

This section evaluates the effect of the Proposed Action on the provision of fire, police, school, and nonhazardous solid waste facilities and services to adjacent and nearby communities. Estimates of the increased levels of service needed as a result of the Proposed Action were made and evaluated.

Personnel statistics for employees at the Livermore Site and Site 300 are combined; thus, some of the projections and analyses in this section discuss impacts of employee growth at the Livermore Site and Site 300 as a single entity.

5.3.3.1 Relationship with Site Operations

This section summarizes the relationship between projects described in Section 3.3 for the Proposed Action and the community services impact analysis. In general, the effect of projects under the Proposed Action on community services is related to additional employment opportunities and changes in floorspace. Employment under the Proposed Action is detailed in Section 5.3.2. New construction projects, as listed in Section 3.3, would add to floorspace, but D&D projects, as part of an overall consolidation program, would decrease floorspace. Employment parameters are listed in Table 5.3.3.1–1.

**TABLE 5.3.3.1–1.—Input Parameters for Community Services Analysis
Under the Proposed Action**

Parameter	Units	Site	No Action Alternative	Proposed Action
Employment	Number of personnel	Livermore Site	10,650	11,150
		Site 300	250	250

5.3.3.2 Impact Analysis

Livermore Site

Fire Protection and Emergency Services

The Livermore Site has its own onsite fire protection services. Currently the Livermore Site Fire Department participates in an automatic aid agreement with the Livermore-Pleasanton Fire Department and a mutual aid agreement with the Alameda County Fire Patrol to serve the Livermore Site.

For purposes of evaluating impacts of the Proposed Action, square footage at the Livermore Site was assumed to decrease by 1 percent from the No Action Alternative. Under their automatic aid agreement, the Livermore-Pleasanton Fire Department responds to an average of three calls per year at the Livermore Site. No increase in the number of calls to the Livermore-Pleasanton Fire Department would be anticipated because of the Proposed Action. The average of three calls per year at the Livermore Site for the Livermore-Pleasanton Fire Department, would not impact that agency's ability to provide fire protection and mutual and automatic aid service under the No Action Alternative. Because the Proposed Action would not increase the number of calls, there would be no impacts on the Livermore-Pleasanton Fire Department.

The Alameda County Fire Patrol did not respond to any Livermore Site Fire Department calls from 1999 to 2001. Implementation of the Proposed Action would not increase the number of calls for assistance over the No Action Alternative. Therefore, the Proposed Action would not affect the Alameda County Fire Patrol's ability to provide fire protection within its service area or carry out its mutual aid responsibilities with other agencies.

Police Protection and Security Services

The Livermore Site provides onsite security services and participates in emergency response agreements with the city of Livermore Police Department and Alameda County Sheriff's Department for additional police protection services at the Livermore Site. The 5 percent increase in Livermore Site employees could raise the number of calls for assistance by one to two per year. This would be less than 0.01 percent of total calls to the Livermore Police and Alameda County Sheriff's departments, and would not impact the ability of the departments to provide service to the community.

School Services

A secondary effect of the Proposed Action would be an increase in student enrollment in those school districts where Livermore Site employees reside. Some of these school districts could accommodate the increase in student enrollment generated by the Proposed Action. However, other school districts in the region could have more limited enrollment capacity and would be subject to an enrollment demand that could be considered an adverse impact.

Due to the high proportion of new hires and their families projected to reside in the Livermore area, further evaluation of the demand for school services focuses on the Livermore Valley Joint Unified School District.

The Livermore Valley Joint Unified School District encompasses approximately 240 square miles of service area, including the city of Livermore, portions of unincorporated Alameda County, and a small portion of unincorporated Contra Costa County. Because the unincorporated areas served have a relatively low population density, the vast majority of the population served by the school district resides within the city of Livermore. This analysis makes the simplifying and conservative assumption that all district students are city of Livermore residents.

Approximately 37 percent of the new personnel under the Proposed Action would reside in Livermore. Based on the 2001 ratio in the Livermore Valley Joint Unified School District enrollment per Livermore resident (13,899 students for 73,345 residents, or 19 percent),

approximately 100 more new students would be enrolled under the Proposed Action than under the No Action Alternative (19 percent of the 520 new residents, as explained in Section 5.3.2.2).

Additional students generated from increased employment at the Livermore Site would be added to the school system incrementally from the year 2004 to 2014. Though several district schools are near capacity, there is currently adequate space district-wide (Miller 2003). The Livermore Draft General Plan (City of Livermore 2003) states “[f]uture growth shall not exceed the community’s capability to provide services” and notes school classroom facilities as one of the principal factors considered. The 100 student increase represents 0.7 percent of district enrollment. Based on an expected annual enrollment growth rate of 1.5 percent based on Livermore’s Housing Implementation Plan, the 100 student increase would be 3.7 percent of the total enrollment growth by 2014. Because the district’s facilities are adequate to meet current student demand, the addition of 100 students to the existing facilities would have minimal impact on the district’s ability to plan for and provide service within its jurisdiction.

Under the Proposed Action, the employment of 500 new workers at LLNL would lead to creation of an additional 500 indirect jobs within the ROI as discussed in Section 5.3.2. Because of the relatively high proportion of new LLNL workers that would reside in the city of Livermore, some of those additional jobs would likely be created within the community. If the distribution of indirect worker residences were the same as for LLNL workers, 100 students could be added to the Livermore Valley Joint Unified School District in addition to the 100 students projected for LLNL workers described above. However, the actual number of students added through indirect jobs would be much less than 100, as many of the additional jobs and worker residences to support LLNL workers residing in Livermore would be created in neighboring communities and other areas throughout the ROI.

Nonhazardous Solid Waste Disposal

Projections for nonhazardous solid waste generation were based on the estimated personnel increases associated with the Proposed Action. This method of analysis was used because existing data on the volume of nonhazardous solid waste generated by the Livermore Site are aggregate figures that do not distinguish waste generated by building type or by program. Thus, the most accurate measure of the increase in nonhazardous solid waste generation was assumed more closely associated with the increase in personnel generated by the Proposed Action.

Estimated increases in nonhazardous solid waste are related to the assumed increases in site employment. Based on an existing workforce level of approximately 10,350 persons and a generation rate of solid waste for disposal of approximately 4,700 metric tons per year, the Livermore Site generates 0.5 metric tons of solid waste per worker per year, which is disposed of at the Altamont Landfill. The estimated increase in the workforce of 500 personnel over the No Action Alternative would result in an increase of approximately 300 metric tons of solid waste per year taken to the landfill. This increase would occur gradually over the timeframe of 2004 to 2014; the projected increase accounts for current source reduction and recycling strategies, but not future strategies or technologies.

The projected lifespan of the Altamont Landfill under current conditions extends to the year 2038 (Hurst 2003). While the Livermore Site is a major generator of solid waste within the

county, the additional 300 metric tons of solid waste generated at the Livermore Site under the Proposed Action could be accommodated by the existing landfill. The increase in solid waste under the Proposed Action would represent only 0.01 percent of permitted landfill throughput. Therefore, due to the remaining lifespan and capacity of the Altamont Landfill, there would be minimal impacts to solid waste disposal within the county.

Site 300

Fire Protection and Emergency Services

Site 300 has its own onsite fire protection services. Currently, the Site 300 Fire Department participates in mutual aid agreements with the city of Tracy Fire Department, Tracy Rural Fire Protection District, and State of California Department of Forestry.

During the years 2000 through 2002, the Site 300 Fire Department and the city of Tracy Fire Department did not respond to any calls in each other's jurisdictions under their mutual aid agreement. The number of mutual aid responses would not increase for either agency under the Proposed Action, which would include no increase in building gross square footage at Site 300. Therefore, the Proposed Action would have no impact on the city of Tracy Fire Department's ability to provide fire protection services or mutual aid services.

Through mutual aid, the Tracy Rural County Fire Protection District currently responds to an average of one call per year at Site 300. The Site 300 Fire Department has never received a request for assistance from the Tracy Rural County Fire Protection District. The number of responses for each agency would not increase under the Proposed Action. Therefore, the Proposed Action would not impact the Tracy Rural County Fire Protection District's ability to provide fire protection within its service area or to fulfill its mutual aid responsibilities with other agencies.

Site 300 also participates in a mutual aid network with the California Department of Forestry. The Proposed Action would not impact the California Department of Forestry's ability to provide fire protection and mutual aid service.

The Proposed Action would not impact fire protection services onsite. There would be no need for increased interaction with offsite agencies.

Police Protection and Security Services

Site 300 provides onsite security services and participates in an emergency response agreement with the San Joaquin County Sheriff's Department for additional police protection services. Because the number of employees at Site 300 would be the same as projected under the No Action Alternative, the Proposed Action would not result in a need for increased security services onsite. No additional impacts are expected.

School Services

The existing setting and impact analysis for school services are combined for the Livermore Site and Site 300. Minimal impacts are expected. (See the discussion of school services under the Livermore Site heading above.)

Nonhazardous Solid Waste Disposal

The number of Site 300 employees under the Proposed Action is the same as under the No Action Alternative. No additional impacts to nonhazardous solid waste disposal would be anticipated.

5.3.3.3 Cumulative Impacts

Cumulative effects associated with planned and approved projects in the area would contribute to the cumulative demand for fire and police services in the jurisdictions for which LLNL has mutual aid agreements. However, because fire and security services at LLNL are independent departments at the Livermore Site and Site 300 and do not rely on offsite community agencies to provide primary responses to fire and police emergency calls, additional demand for these onsite services associated with the Proposed Action would not add to the cumulative demand for offsite fire and police services.

The Proposed Action would contribute to the cumulative demand for school services in the region. Existing school facilities cannot accommodate student generation from cumulative development within the district's jurisdiction. The Proposed Action would contribute approximately 100 students to the cumulative student population. As new school capacity will be required for the 2,700 additional students projected during the next 10 years, the portion of the student increase attributable to the Proposed Action (3.7 percent) would be within extra capacity design criteria.

The Proposed Action would contribute to the cumulative demand for solid waste disposal service associated with planned and approved projects in the area. The Livermore Site sends solid waste to the Altamont Landfill. The landfill operator has projected that the lifespan of this landfill will extend to the year 2038. With existing landfill capacity in Alameda County, the additional solid waste generated under the Proposed Action would not affect solid waste disposal services.

5.3.4 Prehistoric and Historic Cultural Resources

This section presents an evaluation of the impacts to cultural resources resulting from implementation of the Proposed Action. The impact analysis is organized by location and type of resource. Steps taken to reduce impacts are also discussed, as are the measures to be implemented to ensure compliance with the NHPA.

5.3.4.1 Relationship with Site Operations

This section summarizes the relationship between projects described in Chapter 3, Section 3.6, under the Proposed Action and the analysis of cultural resources. In general, those projects with

the potential to impact these resources include construction of new facilities and infrastructure; and D&D, rehabilitation, and renovation of existing facilities.

5.3.4.2 *Impact Analysis*

Livermore Site

The probability of impacting prehistoric resources at the Livermore Site would be very low because: (1) field and archival research have not identified any prehistoric resources; (2) the geomorphic setting of the site makes it unlikely that any such resources exist; and (3) extensive modern horizontal and vertical development has disturbed much of the site. Although no impacts to prehistoric resources would be expected, unrecorded subsurface prehistoric resources still could be inadvertently discovered during construction or other ground-disturbing activities.

To address the inadvertent discovery of cultural material, LLNL would require its employees and contractors to report any evidence of cultural resources unearthed during ground-disturbing activities at the Livermore Site. Work within the immediate vicinity of the discovery would cease until a qualified archaeologist had the opportunity to assess the discovery. If the discovery were deemed potentially significant, work would be stopped until an appropriate treatment plan was developed according to DOE guidelines. NNSA expects no impacts to these resources.

Implementation of the Proposed Action would have the potential to affect important historic buildings and structures on the Livermore Site through D&D, rehabilitation, and renovation of existing facilities. However, implementing the Programmatic Agreement (Appendix G) would avoid, reduce, or mitigate any impacts from these actions.

Site 300

Impacts to known prehistoric and historic resources at Site 300 would be unlikely to result from the Proposed Action. NNSA recognizes the sensitivity of the resources and has established buffer zones to protect them. Implementation of the Programmatic Agreement (Appendix G) and continuation of current management practices would result in protection of these sensitive areas. Although no impacts to known resources would be expected, unrecorded subsurface prehistoric or historic resources still could be inadvertently discovered during construction or other ground-disturbing activities.

The inadvertent discovery of cultural material, at Site 300 would be addressed as described above for the Livermore Site. NNSA expects no additional impacts to these resources.

The Proposed Action would have the potential to affect important historic buildings and structures on Site 300 through D&D, rehabilitation, and renovation of existing facilities. However, implementing the Programmatic Agreement (Appendix G) with responsible state and Federal agencies would avoid, reduce, or mitigate any impacts from these actions.

5.3.4.3 *Cumulative Impacts*

The Livermore Valley has undergone tremendous growth and development over the past decade. Because preservation measures such as Section 106 are only initiated when Federal agencies are

involved, it is likely that the onset of development has caused the irretrievable loss of cultural resources in the region. Because cultural resources exist at both the Livermore Site and Site 300, future program activities could result in resource loss and add to regional attrition of these resources. Any potential impacts to cultural resources at LLNL would be mitigated through implementation of the Programmatic Agreement (Appendix G), thereby reducing LLNL's contribution to resource attrition.

5.3.5 Aesthetics and Scenic Resources

This section analyzes the impact to aesthetics and scenic resources associated with implementation of the Proposed Action.

5.3.5.1 Relationship with Site Operations

This section summarizes the relationship between the projects described in Section 3.3 under the Proposed Action and the analysis of aesthetics and scenic resources. In general, effects to aesthetics and scenic resources would be limited to construction of buildings and infrastructure located in areas visible to public viewing.

5.3.5.2 Impact Analysis

Livermore Site

Activities under the Proposed Action that would change the built environment at the Livermore Site would include improvements to existing buildings and infrastructure, D&D of existing buildings, and construction of new facilities. Developments and modifications would largely occur within the developed portion of the site, would be similar in character to surrounding uses, and would be largely screened from public view by the surrounding fences and trees. Developments and modifications would be largely consistent with the existing character of the site. Therefore, no additional impacts to visual resources are expected.

Site 300

Activities under the Proposed Action that would change the built environment at Site 300 would include improvements to existing buildings and infrastructure, and construction of new facilities. Development and modifications would largely occur within the developed portion of the site in the GSA and would be similar in character to surrounding uses. Although many specifics of these developments under the Proposed Action are not presently known, based on previous LLNL landscaping and development practices, development of these projects at Site 300 would be largely consistent with the existing character of the site.

Under the Proposed Action, the location, type, and extent of improvement activities at Site 300 would be similar to the No Action Alternative. The site would remain compatible with local and county scenic resource plans and policies. Two new buildings, the HEDC and the EMPC, would be constructed under the Proposed Action; however, both buildings would be located within areas that already contain buildings or structures. Consequently, the changes to the built environment because of the Proposed Action would still have no impacts on the visual character

of Site 300, views of the site from public viewing areas, or existing view sheds of the surrounding environment.

5.3.5.3 *Cumulative Impacts*

There are no planned projects near the Livermore Site and Site 300 that, in combination with LLNL activities, would have an adverse effect on existing view sheds or the surrounding environment. There would be no cumulative impacts to aesthetics and scenic resources in the region under the Proposed Action.

5.3.6 *Geology and Soils*

This section analyzes the impact to geology and soils associated with implementation of the projects described in Section 3.3 under the Proposed Action. The impact analysis is organized by geologic resources, topography and geomorphology, and geologic hazards. The Proposed Action includes those actions and facilities described under the No Action Alternative.

5.3.6.1 *Relationship with Site Operations*

Under the Proposed Action, future facilities would be located in the undeveloped areas at the Livermore Site in addition to those facilities described under the No Action Alternative (Figure 5.3.6.1–1). These facilities are listed in Table 5.2.1.2–1. Any future development in the developed areas would affect soils that have already been disturbed.

Under the Proposed Action, the EMPC would be built at Site 300 in addition to the Wetlands Enhancement Project and the connection to the Hetch Hetchy Aqueduct (see Section 5.2.6). The EMPC would replace facilities that are more than 40 years old and allow for the continued support of the Stockpile Stewardship Program.

5.3.6.2 *Impact Analysis*

Geologic Resources

Livermore Site

No known aggregate, clay, coal, or mineral resources would be adversely affected by the Proposed Action. None of the activities under the Proposed Action would take place on or upon known or exploitable mineral resources, unique geologic outcrops, or other unique geologic features. No impacts from farming or grazing activities are expected.

No new facilities would be built in the undeveloped zone at the Livermore Site under the Proposed Action. A total of 462,000 square feet of land would be disturbed because of the construction that would proceed under the No Action Alternative, which would also proceed under the Proposed Action.

As discussed in Chapter 4, Section 4.8, fossils were discovered in the peripheral parts of the excavation for the NIF. The fossil localities were found 20 to 30 feet below the present surface. Under the Proposed Action, the potential would exist for the inadvertent excavation of fossils within the depth range during construction. Should any buried fossil materials be encountered, LLNL would evaluate the materials and proceed with recovery in accordance with requirements of the *Antiquities Act*.

Site 300

No known aggregate, clay, coal, or mineral resources would be adversely affected by the Proposed Action. The impacts would be the same as described in the No Action Alternative, except the proposed construction of the EMPC. Under the Proposed Action, the EMPC, a 40,000-square-foot facility, would be constructed in the southeast quadrant of Site 300 to replace Buildings 805, 806, and 813. An additional building and three new magazines would also be built (see Appendix A). The total area to be disturbed would be approximately 100,000 square feet, only one third or about 33,000 square feet of which would occur in previously undisturbed soils. No projects would involve disturbing new areas. The EMPC would involve the disturbance of a larger area in a previously disturbed site. Therefore, there would be minimal impacts to soils at Site 300.

Several vertebrate fossil deposits have been found on Site 300 near Corral Hollow. The fossil finds are generally widely scattered, and no significant invertebrate or botanical fossil locales have been identified on Site 300 or in the surrounding area (Hansen 1991). Under the Proposed Action, there would be no impacts to any known fossil deposits. There would be no impacts to any known or exploitable mineral resources or unique geologic features. Should any buried fossil materials be encountered during any construction, LLNL would evaluate the materials and proceed with recovery in accordance with the requirements of the *Antiquities Act*.

Topography and Geomorphology

Livermore Site

The Proposed Action would not include project work that would impact the topography or geomorphology of the Livermore Site and no construction or excavation projects are planned that would alter the overall character of the landscape. Only the best management practices would be employed to minimize erosion resulting from ongoing operations; no additional impacts are expected.

Site 300

The Proposed Action would not include project work that would impact the topography or geomorphology of Site 300, and no construction or excavation projects would alter the character of the landscape. Only the best management practices would be employed to minimize erosion resulting from ongoing operations; no additional impacts are expected.

Geologic Hazards

The geologic hazards associated with the Livermore region are part of the character of that region. The hazards exist regardless of the presence of human activities, buildings, or facilities. Therefore, there is no difference in the geologic hazards among the alternatives. Chapter 4, Section 4.8, and Appendix H, Seismicity, include information regarding potentially strong earthquake ground motion sources and the major regional fault zones and local faults. Potential impacts expected from an earthquake generating a horizontal peak acceleration of 0.73 g are discussed as part of the evaluation of accidents in Section 5.5 and Appendix D, Accident Analysis. The unit g is equal to the acceleration due to the gravity of the earth or 9.8 meters/second/second (32 feet/second/second).

Livermore Site

Adverse impacts to proposed structures, related infrastructure, and surrounding communities could occur from hazardous materials releases and/or structural failure of buildings and facilities following a major seismic event. Design and location requirements for new facilities built under the Proposed Action would take into account distance from active faults and the ground shaking to be expected within certain probabilities.

Site 300

There is potential for seismically induced landslides at Site 300 due to steep slopes and existing landslide deposits. The potential for slope instability is greater on northeast-facing slopes that are underlain by the Cierbo Formation. Buildings 825, M825, 826, M51, 847, 851A, 851B, 854, 855, and 856 are located on old landslides deposits. The potential for ground deformation at these buildings is considered to be moderate to high. The EMPC location is not underlain by landslide deposits and therefore, has low potential for ground deformation.

A landslide could result in spills, fire, explosions, or burial of facilities within its path. The hazards and impacts of spills, fire, and explosions, regardless of cause are discussed in Section 5.5 and Appendices A and D. The impacts of burial of materials due to a landslide would be similar to spills and the firing of explosives at these facilities. These facilities have material limits under which they work on batches of materials. The working limits for explosives are close to the amounts detonated at the firing sites. The spread of materials into the environment when the explosives are detonated would be similar to the amount of materials that would be buried in a landslide.

5.3.6.3 *Cumulative Impacts*

SNL/CA projects approximately 100 acres of soil disturbance in connection with their activities and future facilities. A large portion of this disturbance would occur within areas that are already developed. The soils near LLNL are capable of supporting agriculture. While there is a large amount of undeveloped land in Alameda County, continuing development in the immediate vicinity of LLNL is contributing to the cumulative loss of agricultural land. The projects associated with the Proposed Action would not contribute to the overall loss of agricultural land since LLNL has been committed to R&D/industrial use instead of agriculture for decades.

5.3.7 Biological Resources

This section describes the impacts to biological resources under the Proposed Action. Chapter 4, Section 4.9, describes the existing biological conditions and current operations that impact or may impact biological resources. A more detailed discussion of the biological resources and the impacts of current operations appears in Appendix E, Ecology and Biological Assessment, and Appendix F, Floodplain and Wetlands Assessment.

5.3.7.1 *Relationship with Site Operations*

This section summarizes the relationship between projects described in Chapter 3, Section 3.3, for the Proposed Action and the ecological impact analysis. In general, the effect of Proposed Action projects on biological resources would occur primarily in areas that have been previously disturbed at the Livermore Site and Site 300 by construction, maintenance, wildfire prevention, and security activities.

5.3.7.2 *Impact Analysis*

Vegetation and Wildlife

Livermore Site

Under the Proposed Action, no additional facilities would be constructed in undeveloped areas other than those described in the No Action Alternative. The impacts of the Proposed Action on vegetation and wildlife would be minimal and similar to those for the No Action Alternative.

Site 300

Site 300 vegetation and wildlife consist of a wide range of plant and animal species. The impacts of the Proposed Action on vegetation and wildlife would occur primarily in previously disturbed areas representing less than 5 percent of the total site acreage. Under the Proposed Action, the EMPC would be constructed in the southeast quadrant of Site 300. This planned facility would result in the disturbance of approximately 40,000 square feet (approximately 0.9 acre) of soil and associated vegetation. The loss of less mobile animals such as small mammals and reptiles could occur. The facility would replace Buildings 805, 806, and 813. The operations of Building 807 would move to the EMPC, but Building 807 would be retained and waste packaging operations from Building 805 would be moved to Building 807. The EMPC would house modern explosives machining, pressing, assembly, inspection, and some radiography. An additional building would provide an inert machine, offices, and shower/change room facilities. Three magazines capable of storing 1,000 pounds of explosives each would also be built (LLNL 2002ap). A number of routine operations such as road grading and culvert maintenance would occur and include protective measures as detailed in Appendix E, Section E.2.2.

Tritium Levels in Vegetation and Commodities

The Proposed Action projects no releases of tritium above that in the No Action Alternative. A detailed discussion of tritium levels for the No Action Alternative is presented in Section 5.2.7.2.

Protected and Sensitive Species

Livermore Site

Under the Proposed Action, LLNL would continue to fulfill its obligation to maintain Arroyo Las Positas (previously modified to handle a 100-year flood event) and onsite tributaries for flood capacity. The objective of the Arroyo Las Positas Maintenance Project is to allow the function and needs of onsite drainage capacity of the arroyo to be met in a timely and consistent manner without overlooking the preservation and habitat conservation requirements pertaining to the federally threatened California red-legged frog (LLNL 1998a, USFWS 1997, USFWS 2002e). For further details of the Arroyo Las Positas Maintenance Project and ongoing consultation with the USFWS for this project, see Appendix E, Section E.2.1.

No California red-legged frogs have been identified in 1,800 feet of the Arroyo Seco within the Livermore Site boundaries from the Vasco Road bridge to the East Avenue culvert (LLNL 2003ab). However, this segment of Arroyo Seco could be used by populations of that species in the vicinity of the site. A separate Biological Assessment prepared to assess the impacts of the proposed Arroyo Seco Management Plan was submitted to the USFWS in August 2003.

Formerly designated critical habitat for the California red-legged frog at the Livermore Site proposed by the USFWS for reinstatement is shown in Chapter 4, Figure 4.9.3–1. Construction of new structures under the Proposed Action would include No Action Alternative projects, such as the BSL-3 Facility and the Edward Teller Education Center. The proposed projects at the Livermore Site would not be in or affect proposed designated critical habitat for the California red-legged frog, or areas where this species typically occurs.

Measures to protect the California red-legged frog during Arroyo Las Positas Maintenance Project activities would continue using the same USFWS-approved protection and conservation measures discussed in Section 5.2.7.3. Impacts are expected to be beneficial.

Site 300

Threatened, endangered, and other sensitive flora and fauna species of concern reside at Site 300. Under the Proposed Action, No Action Alternative projects described in Section 3.2 would be completed, as well as other projects described in Section 3.3 for the Proposed Action.

Affected Species and Habitat

The Proposed Action would affect three species: the California red-legged frog, the California tiger salamander, and the Alameda whipsnake, and would involve construction or maintenance activities in proposed, or formerly designated, critical habitat for two of these. The first affected species is the California red-legged frog, a federally listed threatened species. Proposed designated critical habitat for the California red-legged frog at Site 300 is shown in Chapter 4, Figure 4.9.3–3, together with its breeding and nonbreeding locations. Proposed termination of surface water releases for an artificial wetland at Building 865 would impact this species since it has been a known breeding location for 6 years. Termination of water to a small, artificially maintained wetland at Building 801 would eliminate a potential breeding site for this frog species, although no California red-legged frogs occur at this site. Elimination of very small wetlands associated

with the cooling towers at Buildings 851 and 827 would eliminate two low-quality habitat locations for the California red-legged frog where frogs have not been observed for the past 6 years. Appendix E, Section E.2.2.6.1, provides further details on potential impacts of this project and mitigation measures taken to minimize those impacts. Proposed termination of surface releases at Buildings 865, 851, and 827 was coordinated with the USFWS and received approval contingent upon implementation of mitigation measures in a recent Biological Assessment and related Biological Opinion (Jones and Stokes 2001, USFWS 2002b). This proposed termination may start as early as 2004 (LLNL 2003ab). Grading of fire trails disturbs sediment that could indirectly affect California red-legged frog habitat suitability. However, the use of best management practices could reduce adverse effects to this species by minimizing erosion of fire trails into drainages as discussed in Appendix E, Section E.2.2.6.1.

Under the Proposed Action, the EMPC would be constructed in the southeast quadrant of Site 300. A field reconnaissance of the proposed EMPC site was performed in March 2002 to detect the presence of special-status wildlife species and/or their habitats at Site 300. No California red-legged frogs or related breeding areas were detected in the proposed construction area (LLNL 2003cg). The proposed construction location would be within an area where designated critical habitat for the California red-legged frog has been proposed for reinstatement (69 FR 19620, 69 FR 32966). The proposed EMPC site would impact low-quality California red-legged frog habitat. However, this location is within the dispersal capability of California red-legged frogs from known breeding and nonbreeding areas in the southeast quadrant of Site 300. Therefore, a pre-activity survey would be conducted prior to the groundbreaking for the EMPC to minimize the potential for injury or mortality to California red-legged frogs.

The second affected species is the California tiger salamander, a federally listed threatened species. Figure 4.9.3–4 shows wetland locations where this species has been observed at Site 300. Although proposed grading of fire trails, and storm drainage and culvert improvement activities could result in direct mortality of California tiger salamanders, proposed mitigations contained in a recent Biological Assessment and related Biological Opinion would minimize the potential for such adverse impacts (Jones and Stokes 2001, USFWS 2002b). The avoidance and mitigation measures discussed above for the California red-legged frog would also provide protection for the California tiger salamander and its habitat (Jones and Stokes 2001). The California tiger salamander was not observed during a field reconnaissance of the proposed EMPC site performed in March 2002 (LLNL 2003ag). Avoidance measures discussed above for the California red-legged frog would also minimize potential for damage or mortality to the California tiger salamander if the EMPC were constructed.

LLNL is proposing to mitigate the 0.62-acre artificial wetland removed by continued operations at Site 300 under the Proposed Action, by enhancing selected areas and increasing breeding opportunities for the California red-legged frog. A minimum of 1.86 acres of wetland habitat would be enhanced and managed for these two species. Mitigation sites for potential enhancement include the wetlands at the seep at the SHARP Facility and Mid Elk Ravine. This mitigation measure has been previously addressed in a recent Biological Assessment and related Biological Opinion (Jones and Stokes 2001, USFWS 2002b) (see Appendix E, Section E.2.2.9 for more information on this mitigation measure).

The third affected species is the Alameda whipsnake, a federally listed threatened species. Figure 4.9.3–5 shows formerly designated critical habitat and potential habitat for the Alameda whipsnake at Site 300. Grading of fire trails and prescribed burns in grasslands adjacent to Alameda whipsnake habitat in sage scrub and rock outcrops have the potential to affect this species. However, a Biological Assessment and related Biological Opinion address mitigations that would minimize the adverse effects from these proposed activities (Jones and Stokes 2001, USFWS 2002b). Fire trail maintenance and prescribed burns are annual activities that would continue during the 10-year period covered by this LLNL SW/SPEIS. Appendix E, Section E.2.2.6.2, provides further details on measures taken to minimize impacts of the Proposed Action on this species. Impacts are expected to be minimal.

Unaffected Species

Activities associated with the Proposed Action would not occur in areas that would affect the following federally listed endangered, threatened, or candidate species: the large-flowered fiddleneck, the San Joaquin kit fox, the valley elderberry longhorn beetle, and the willow flycatcher. Protection and conservation measures discussed in Section 5.2.7.3 would also be conducted under the Proposed Action. Impacts are expected to be minimal, if any.

Wetlands

Livermore Site

Under the Proposed Action, No Action Alternative projects and additional projects would be constructed. Construction of new buildings under the Proposed Action would occur in upland areas so that land clearing would not be anticipated to have direct or indirect impacts on natural wetlands. Wetlands along Arroyo Las Positas could be impacted if discharged treated water from the Environmental Restoration Program is terminated; although such termination is not being considered under the Proposed Action during the time period covered by the LLNL SW/SPEIS (LLNL 1998a). Future actions involving these wetlands may require consultation with the USACE and the San Francisco Bay Regional Water Quality Control Board, such as ongoing efforts to develop a water management plan for an 1,800-foot segment of Arroyo Seco within Livermore Site boundaries from the Vasco Road bridge to the East Avenue culvert (LLNL 2001ap). Additionally, the State of California has a no net loss policy regarding wetlands, including artificial wetlands. No impacts are expected.

Site 300

Under the Proposed Action, construction of the EMPC would occur using best management practices to avoid runoff that could affect wetlands. Additionally, a No Action Alternative wetland enhancement project would be constructed to protect and enhance a minimum of 1.86 acres of wetland habitat in association with the termination of artificial wetlands, totaling approximately 0.62 acres, that have been created by cooling tower runoff near Buildings 801, 827, 851, and 865 (Jones and Stokes 2001, USFWS 2002b). This project is discussed in Section 5.2.7. Impacts are expected to be minimal.

5.3.7.3 Cumulative Impacts

Under the Proposed Action, approximately 732,000 square feet (approximately 16.8 acres) of terrestrial habitat at the Livermore Site would be disturbed due to proposed construction activities, a 34 percent increase over soil disturbance under the No Action Alternative (see Section 5.3.6.2). Approximately 40,000 square feet (approximately 0.9 acres) of soil disturbance would be required for construction of the EMPC in the more developed part of Site 300, and some additional soil disturbance would occur for continuing operations, such as road grading and culvert maintenance (see Appendix E). SNL/CA is managing its section of Arroyo Seco to protect California red-legged frog habitat and create a 30-acre wildlife reserve on the east side of that facility. The incremental effect of the Proposed Action on biological resources within the area would be positive, particularly in the long term.

5.3.8 Air Quality

5.3.8.1 Nonradiological Air Quality

Relationship with Site Operations

Similar to the discussion in Section 5.2.8.1, the Proposed Action is for the most part a continuation of current activities. In addition, there are a number of new projects such as facility upgrades, D&D activities, and new facility construction. The scope of these activities under the Proposed Action would be somewhat greater than under the No Action Alternative. Because these types of activities are normal during any 10-year period, potential air quality impacts of planned activities associated with the Proposed Action are considered in relation to current activity levels and are compared to those of the No Action Alternative. The general parameters that will be used in the analyses of potential air quality impacts are listed in Table 5.3.8.1–1.

Impact Analysis

Modifications to Facilities or Operations

Facility and infrastructure renovations (e.g., replacement of ductwork, roofs, installation of seismic and physical security upgrades, and repairs and modifications to roads) and new facility construction are normal during any 10-year period. Many such activities are planned under the No Action Alternative, but under the Proposed Action, the activity level and potential air quality emissions would be about three times that of the No Action Alternative. As discussed earlier, LLNL adheres to stringent requirements to ensure that air emissions are mitigated to the extent practicable, throughout the design, review, and implementation phases of modification activities. While the increased activity would result in a comparable increase in air emissions, primarily fugitive dust and combustion exhaust from increased vehicular activity and employment of construction equipment, with the use of stringent measures to control construction emissions as discussed in Section 5.1.8.1, the impact would not be significant.

New Facilities

The No Action Alternative includes some new facilities such as the NIF, Terascale Simulation Facility, and International Security Research Facility. The Proposed Action would additionally consolidate several programs within new structures. At the Livermore Site, these new facilities would increase utilized space by about 10 percent over that planned under the No Action Alternative. At Site 300, planned new space would be offset by the removal of a similar amount of obsolete space. At both sites, however, space utilization would not differ appreciably from current allocations. In fact, many of the activities to be housed within new structures are ongoing activities that would be relocated and/or consolidated. Activity relocations would be reviewed for compliance with air permit requirements in relation to their new settings. Where activities would require new air permits or modifications to existing air permits, these would be secured prior to construction or operation.

The increase in facility space at the Livermore Site would result in some additional fuel use. Natural gas is used in boilers, and diesel fuel is used in generators. Both are tested periodically. Several criteria and toxic air contaminants are emitted from fuel combustion. Oxides of nitrogen are a concern locally as a contributor to ozone formation. The increased fuel use anticipated under the Proposed Action would result in an increase in oxides of nitrogen emissions over the No Action Alternative. Actual oxides of nitrogen emission levels may be limited by site-wide emission caps under the Synthetic Minor Operating Permit discussed in Chapter 4, Section 4.10.4.3. Impacts would be limited by air district offset requirements. Because fuel combustion sources are recognized as potentially significant sources of criteria pollutant emissions, LLNL has enacted standard measures, as described in Section 5.2.8.1, to mitigate emissions from this source category.

Decommissioning, Decontamination, and Demolition

As discussed in Section 5.2.8.1, LLNL has pursued removal of substandard space as part of a campaign to reduce the amount of active nonassignable space and optimize the use of existing space. The Proposed Action would include removal of 690,899 gross square feet at the Livermore Site, and 129,535 gross square feet at Site 300. Although this rate would be higher than recent years, strict compliance with air district requirements to limit fugitive dust emissions, and continuing to employ standard measures to control pollution from D&D activities would limit the impact of these activities.

Support Personnel and Vehicular Activity

The Proposed Action requires a projected increase in workforce, adding 500 employees and other site workers at the Livermore Site by the year 2014, and a corresponding increase in daily vehicular activities, primarily workers commuting to and from the site. Impacts of workforce commute on air quality would be lessened through transportation demand management. A large employment center holds more opportunities for alternatives to the single-employee commute. LLNL's transportation systems management program provides and promotes alternatives and environmentally responsible options for employee commuting. LLNL is committed to continuing this program.

The additional workforce would include some relocated employees new to the Bay Area air basin. Activities of the relocated population would contribute to air emissions associated with the commute to the workplace and secondarily from the additional energy consumption, other vehicular use, and goods and services that would be required to support the additional, relocated population. The jobs created under the Proposed Action at LLNL represent a small fraction (less than 1 percent) of the projected increase in employment within Alameda County over the 2000 to 2010 timeframe (Association of Bay Area Governments 2001). The air quality impact of this population growth would be on the same order as that of the growth rate, and this is well within the projections developed by the Association of Bay Area Governments, Metropolitan Transportation Commission and BAAQMD, and employed in the Clean Air Plan. Therefore, impacts are expected to be minimal.

Conformity

Livermore Site

To demonstrate conformity, the following analysis provides a conservatively high assessment of air emissions associated with activities planned under the Proposed Action: construction, maintenance and operations including R&D activities in planned facilities, increased demand for building heating, demolition activities, and increased vehicular use.

Construction activities account for a large portion of the projected maximum annual emissions, which include, particulate emissions from soil disturbance and combustion-related emissions from stationary engines and vehicles. To project a worst-case annual emission scenario, it is conservatively assumed that a large fraction of the proposed 10-year construction activities will occur in a single year, accounting for a disturbed area of 335,000 square feet (or 7.7 acres) of facility construction and D&D, and one acre for Westgate Drive improvements. An emission factor of 0.11 tons PM₁₀ per acre-month recommended by the CARB (CARB 2004) was assumed, which includes the mitigating effect of applying water for dust control, a requirement in California.

D&D projects (which are similar to construction projects in terms of emissions) will be conducted over the 10-year period, however, for the purposes of this assessment, it is assumed that a worst case year for D&D would be 150,000 square feet, allowing for a conservatively high annual emission estimate.

Construction, demolition and some maintenance activities require the use of tools and equipment powered by internal combustion engines, typically diesel-fueled engines. For the Proposed Action, it is conservatively estimated that the equivalent of two additional engines, each rated at 250 horsepower would be used for these construction-related activities, together operating a maximum 1,936,000 horsepower-hours during the year. The criteria pollutant emissions are estimated using emission factors recommended by EPA (AP-42) for uncontrolled gasoline and diesel industrial engines, although this clearly overestimates the emissions. As stated, LLNL requires the use of late model, cleaner burning engines (Tier I or Tier II) for construction, and engine performance and fuel specifications will satisfy all state and Federal requirements at the time.

For the Proposed Action, it is estimated that the construction projects will result in an increase of 10 heavy-duty vehicle trips per day, at 40 miles per trip, for eleven months resulting in an

additional 132,000 vehicle-miles per year. Emissions were calculated using the highest (i.e., most conservative) 2002 emission factors for on-road delivery vehicles (SCAQMD 2004). The Proposed Action will result in an increase of 500 vehicle-trips per day, at 20 miles per trip, for 22 working days per month, for 12 months.

Operational emissions from proposed R&D activities housed in newly-constructed facilities are typically on the order of a few pounds per day. For the purpose of this analysis, it is assumed that, in addition to the expected maximum 0.4 tons per year precursor organic compounds estimated for No Action Alternative facility operations, activities in each of two new Proposed Action buildings would result in an additional 0.4 tons per year (for a total of 0.8 tons per year). Similarly, space-heating requirements in the additional facility space would result in additional fuel use, 2,400 million BTU per year, over that of the No Action Alternative.

Estimated total increased air emissions at the Livermore Site under the Proposed Action are presented in Table 5.3.8.1–2. The emissions estimates are well below the applicable conformity thresholds; therefore, the Livermore Site projects proposed under the Proposed Action are in conformance with CAA requirements and exempt from further analysis.

TABLE 5.3.8.1–2.—Increased Emissions for the Livermore Site Under the Proposed Action (tons per year) For an Assumed Worst-Case Year

Emission Source	NO _x	CO	SO _x	PM ₁₀	VOC
Construction Engines ^a	19	2.8	2.0	0.88	1.1
Construction Vehicles ^a	0.18	1.1	0.001	0.006	0.13
Construction Dust ^a	-	-	-	9.54	-
Boiler Space Heating	0.12	0.20	-	0.018	0.86
Research Laboratories	-	-	-	-	0.8
Personal and Transport Vehicles	2.8	16	0.11	1.6	0.85
Totals	22	20	2.1	12	3.8
Conformity Threshold ^b	100	100	-	100 ^c	100
2002 Livermore Site Emissions from Permitted Equipment	24	6.2	1.0	2.2	5.8

^a Category includes renovations, infrastructure improvements and demolition activities.

^b Conformity thresholds are related to the regional classifications with respect to air quality standards. These are discussed in detail in Section 5.2.8.1.

^c PM₁₀ is unclassified with respect to the NAAQS. The listed conformity threshold is provided for comparative purposes, but does not strictly apply.

Site 300

Maximum annual criteria pollutant emissions from activities at Site 300 under the Proposed Action are presented in Table 5.3.8.1–3. Particulate emissions from construction and demolition activities assume a total of 3.05 acres disturbed, and an additional 2.48 acres associated with the Wetlands Enhancement project. Construction, demolition and some maintenance activities require the use of tools and equipment powered by internal combustion engines, typically diesel-fueled engines. At Site 300, it is conservatively estimated that the equivalent of one engine, rated at 250 horsepower would be used for 8 hours per day, 22 days per month, for 11 months. The criteria pollutant emissions are estimated using emission factors recommended by EPA (AP-42) for uncontrolled gasoline and diesel industrial engines, although this clearly overestimates the emissions. As stated, LLNL requires the use of late model, cleaner burning engines (Tier I or

Tier II) for construction, and engine performance and fuel specifications will satisfy all state and Federal requirements at the time.

Under the Proposed Action, it is also estimated that the construction projects (EMPC and HEDC) will result in an increase of 5 heavy-duty vehicle trips per day, at 40 miles per trip, for eleven months resulting in an additional 66,000 vehicle-miles per year.

For operational emissions, it is assumed that R&D activities conducted in each of two new buildings emits 2 pounds per day of precursor organic compounds for 200 day (0.4 tons). It is further assumed that the two new facilities each have a 2 million BTU per hour natural gas-fired boiler, which would be fired on average at a rate of 1 million BTU per hour, 8 hours per day, 5 months per year. Air emissions from increased vehicle traffic are estimated at 20 trips per day, 40 miles per trip, for 22-working days per month, for 12 months.

Emissions estimates are well below the applicable conformity thresholds; therefore, Site 300 Proposed Action projects are in conformance with CAA requirements and exempt from further analysis.

**TABLE 5.3.8.1–3.—Increased Emissions for Site 300 Under the Proposed Action
(tons per year) For an Assumed Worst-Case Year**

Emission Source	NO _x	CO	SO _x	PM ₁₀	VOC
Construction Engines ^a	4.8	0.70	0.50	0.22	0.29
Construction Vehicles ^a	0.089	0.56	0.001	0.003	0.06
Construction Dust ^a	-	-	-	4.24	-
Personal and Transport Vehicles	0.04	0.20	0.001	0.020	0.011
Totals	5.0	1.5	0.52	4.5	0.77
Conformity Threshold ^b	10	100 ^b	-	70	10
2002 Site 300 Emissions from Permitted Equipment	0.4	0.37	0.026	0.033	0.084

^a Category includes renovations, infrastructure improvements and demolition activities.

^b Conformity thresholds in the San Joaquin air basin are lower (i.e., more stringent) than those in the Bay Area air basin, owing to the severity of the nonattainment classifications. These classifications are discussed in detail in Section 5.2.8.1.

^c To be conservative, a conformity threshold is provided for CO, which is classified as “Attainment-Unclassified.”

5.3.8.2 Radiological Air Quality

This section analyzes radiological air quality impacts under the Proposed Action due to normal releases from site operations such as R&D and waste management. Impacts in terms of dose related to the Livermore Site and Site 300 are discussed in this section.

Relationship with Site Operations

This section summarizes the relationship between projects described in Section 3.3 for the Proposed Action and radiological air quality. The dose resulting from exposure to routine air emissions from these projects is used to quantify the impacts. The incremental impact for the Proposed Action over the No Action Alternative would be due to additional tritium releases from

Building 331 and additional fission products (most importantly, iodine-131) from the NIF. See Appendix M, Table M.5.3.8.4–1, for information on fission products.

Impact Analysis

Livermore Site

Building 331 annual tritium releases would remain 210 curies for the Proposed Action. The NIF releases of tritium, nitrogen-13, and argon-41, would remain the same as under the No Action Alternative, but additional fission products, including xenon, krypton and iodine isotopes, most importantly 0.93 curies per year of iodine-131, would also be released as a result of the NIF experiments.

The site-wide MEI location would be unchanged from the No Action Alternative, but the dose received from atmospheric emissions would be approximately 0.13 millirem per year, less than 1.5 percent of the NESHAP limit. Fifty-four percent of this dose would be from the NIF.

The population dose from the Proposed Action would be 1.8 person-rem per year, 84 percent of that from Building 331. The NIF would have relatively less affect on the population dose than on the site-wide MEI dose because many of the important nuclides released are short-lived and will decay prior to reaching the general population. The dose to the non-involved worker population would be 0.16 person-rem per year. No health impacts are expected to occur from exposure to normal radiological releases under this alternative (see Section 5.3.14.4).

Site 300

The releases from Site 300 would be the same for the Proposed Action as for the No Action Alternative. The site-wide MEI dose of 0.055 millirem per year, less than 0.6 percent of the NESHAP limit, and population dose of 9.8 person-rem per year and dose to worker population of 0.005 person-rem per year would therefore remain unchanged from the No Action Alternative. No health impacts from radiological air releases are expected from the Proposed Action at Site 300 (see Section 5.3.14.4).

Cumulative Impacts

No adverse impacts on radiological air quality are expected under the Proposed Action. Other than background radiation sources, there are no other known contributors to concentrations of radionuclides in air within 50 miles of the Livermore Site or Site 300. Therefore, there would be no cumulative radiological air quality impacts.

5.3.9 Water

5.3.9.1 *Relationship with Site Operations*

This section summarizes the relationship between projects described in Section 3.3 for the Proposed Action and the water impact analysis. The effect of projects for the Proposed Action on water resources is related to impervious surfaces and runoff from buildings, roads, and their

associated site drainage measures, as well as increased use of potential contaminants resulting from construction and operation of projects under the Proposed Action.

5.3.9.2 *Impact Analysis*

Livermore Site

Surface Water

Surface water monitoring would continue under the Proposed Action in accordance with NNSA guidelines to ensure remediation of contamination already present and detection of hazardous materials in the future. Stormwater monitoring would continue in accordance with NPDES requirements.

Surface water resources could be degraded by contaminant releases during construction of some facilities under the Proposed Action. Contaminant sources could include construction materials; hydraulic fluid, oil, and diesel fuel; and releases from transportation or waste-handling accidents. LLNL stormwater pollution prevention plans have been devised to identify pollutant sources that could affect the quality of industrial stormwater discharges and to describe implementation practices to reduce pollutants in these discharges. In the event of a hazardous spill, necessary equipment to implement cleanup is available, and personnel are trained in proper response, containment, and cleanup of spills. Further guidance on response to hazardous material spills is provided in the ES&H Manual.

Compliance with an approved erosion and sedimentation control plan during construction would prevent impacts to surface water from construction-induced erosion.

The Livermore Site's primary water source is the San Francisco Hetch Hetchy Aqueduct system. The secondary or emergency water source is the Alameda County Flood and Water Conservation District, Zone 7. Approximately 1.37 million gallons per day would be used at the Livermore Site under the Proposed Action, the same as under the No Action Alternative. At the Livermore Site, water would be used primarily for industrial cooling processes, sanitary systems, and irrigation. Minor amounts of water would be used for drinking, manufacturing, washing, system filters, boilers, and a swimming pool.

Under the Proposed Action, the square footage of impervious surfaces at the Livermore Site, primarily roads and buildings, would be approximately 370,000 square feet greater than under the No Action Alternative. Impervious surface area would be 29 percent, a 2 percent increase from the No Action Alternative. An increase in surface runoff would occur because of increased impervious surface areas. However, because Livermore Site soils are relatively permeable and abundant uncovered acreage remains for groundwater recharge, the impact of the reduction in recharge surface area under the Proposed Action would be minimal.

Because no activities under the Proposed Action would occur within the 100-year floodplain, other than the Arroyo Las Positas Maintenance Project, which is covered under an Environmental Assessment (DOE/EA-1272) (DOE 1998b), a separate NEPA document, no impacts to the floodplain would be expected. None of the Proposed Action projects would contribute significant amounts of surface water runoff to cause substantial flooding because the

100-year base flood event would be contained within all channels. Due to the high infiltration rates and lack of appreciable floodplains on the Livermore Site, hydrologic impacts from the Proposed Action would be minimal. No facilities would be located in either the 100-year or 500-year floodplain; therefore, no impact from flooding would be expected.

Groundwater

Groundwater monitoring would continue under the Proposed Action to ensure that remediation of contamination already present continues to be effective and that contaminant fate and transport is fully understood. Groundwater quality should continue to improve because extracted groundwater would be collected and treated at the treatment facilities.

Groundwater resources could be degraded by contaminant releases during construction. Contaminant sources include construction materials, spills of oil and diesel fuel, and releases from transportation or waste-handling accidents. LLNL follows prevention and mitigation steps outlined in the spill response chapter of the ES&H Manual in the event of a hazardous material spill. Because the minimum depth to groundwater at the Livermore Site is approximately 50 feet and employees are trained in emergency spill response procedures, spills would likely be cleaned up before they reach the water table.

Impacts to groundwater from leaking underground storage tanks would not be expected since LLNL complies with all underground storage tank regulations.

Groundwater quality would continue to improve from ongoing remediation at treatment facilities. No negative impacts to groundwater are expected from operation because there would be no discharges to groundwater. Impacts to groundwater quality from surface water recharge would be minimal because LLNL would continue to comply with NPDES requirements.

Site 300

Surface Water

Stormwater monitoring would continue in accordance with NPDES requirements. Surface water resources could be degraded by contaminant releases during construction of new facilities. Contaminant sources could include construction materials, spills of oil and diesel fuel, and releases from transportation or waste-handling accidents. LLNL would follow mitigation steps outlined in the SPCC Plan in the event of a spill of petroleum products. Hazardous material spill response procedures are outlined in the ES&H Manual.

Compliance with an approved erosion and sedimentation control plan during construction would prevent impacts to surface water from construction-induced erosion.

Site 300's No Action Alternative water usage of 0.35 million gallons per day would continue under the Proposed Action.

Under the Proposed Action, developed space at Site 300 would be 80,000 square feet less than under the No Action Alternative, likely decreasing the amount of impervious surfaces. Less development would allow for increased surface area for groundwater recharge. Approximately 1

percent of Site 300 would be covered with impervious surfaces. Because Site 300 is largely undeveloped and contains permeable soils, there would be no noticeable impact to groundwater recharge.

Because no activities under the Proposed Action would occur within the 100-year floodplain, no impacts to the floodplain would be expected. None of the Proposed Action projects would contribute significant amounts of surface water runoff to cause substantial flooding because the 100-year base flood event would be contained within all channels. Due to the high infiltration rates and lack of appreciable floodplains at Site 300, hydrologic impacts from the Proposed Action would be minimal. However, due to the steep slopes, high runoff velocities within the channels could occur during a storm. No facilities would be located in these areas; therefore, no impact from flooding would be expected.

Groundwater

Although the eastern GSA offsite trichloroethylene plume has recently been restricted to Site 300, the plume had extended more than a mile down the Corral Hollow stream channel in the direction of the city of Tracy. Groundwater monitoring would continue under the Proposed Action to ensure that remediation of contamination already present continues to be effective and that contaminant fate and transport is fully understood. Groundwater quality should continue to improve because extracted groundwater would be collected and treated at the treatment facilities.

Groundwater resources could be degraded by contaminant releases during construction. Contaminant sources could include construction materials; spills of hydraulic fluid, oil, and diesel fuel; and releases from transportation or waste-handling accidents. LLNL follows prevention and mitigation steps outlined in the spill response chapter of the ES&H Manual in the event of a hazardous material spill. In all but one area where contamination activity could occur under the Proposed Action, depth to groundwater ranges from approximately 50 feet to more than 180 feet below ground surface. Because the minimum depth to groundwater at Site 300 is approximately 50 feet in areas where activity is expected under the Proposed Action and employees are trained in emergency spill response procedures, spills would likely be cleaned up before they reach the water table.

Impacts to groundwater from leaking underground storage tanks would not be expected since LLNL complies with all underground storage tank regulations.

Groundwater quality should continue to improve from ongoing remediation at treatment facilities. No negative impacts to groundwater are expected from operation because there would be no discharges to groundwater.

Groundwater use would continue as under the No Action Alternative, and no impacts to groundwater availability would be expected under the Proposed Action. If Site 300 gets its water supply from the Hetch Hetchy system as planned, groundwater would no longer be used as the primary water source for Site 300. In this case, more groundwater would be available for other users in the area, thus no impacts would be expected.

5.3.9.3 Cumulative Impacts

Livermore Site

The San Francisco Public Utilities Commission provides water to 2.4 million people in San Francisco, San Mateo, Santa Clara, and Alameda counties, including the Silicon Valley business district. To maintain a reliable water system, the San Francisco Public Utilities Commission initiated regional and local water projects in 2003 to upgrade and repair Hetch Hetchy system facilities. These projects will ensure stability in the case of a seismic event, sufficient water supply for an increasing population, and high-quality drinking water that meets all regulatory requirements. The improvements are scheduled to be completed by the year 2016.

San Francisco Bay Area water use is expected to increase by 64 million gallons per day by the year 2030. This is approximately a 25 percent increase over current water usage. Livermore is projected to use 1.37 million gallons per day under the Proposed Action. This is 0.4 percent of the projected total Hetch Hetchy water supply. Livermore currently uses 0.5 percent of the Hetch Hetchy water supply. Livermore's future contribution to the cumulative Hetch Hetchy water use would remain proportional to current use.

Because much of the land surrounding the Livermore Site is zoned for low-density activities, such as grazing, vineyards, and rural residential, and the large residential parcel to the west of the Livermore Site is basically fully developed (see Chapter 4, Figure 4.2.1.1–1), it is expected that most of the surrounding undeveloped land would not be converted to impervious surfaces in the future. Therefore, cumulative impacts on surface water quality and groundwater recharge from increases in impervious surfaces would be minimal.

With the exception of Livermore Site VOC plumes, no other known contaminant plumes exist in the surrounding area that could cause a cumulative degradation of groundwater quality. Sources of groundwater contamination in Livermore are described in Section 5.2.15.3. Groundwater quality at SNL/CA, located directly south of the Livermore Site, has improved through completion of remediation that began in 1984 on a 59,000-gallon diesel fuel spill. Similarly, groundwater quality should continue to improve in the Livermore Site vicinity with ongoing remediation at water treatment facilities.

Site 300

Site 300 currently receives water from onsite wells and should receive water from the Hetch Hetchy water supply system by early 2004. Water consumption rates have declined steadily since 1992, down to 25.3 million gallons per year in 2002. The new water system capacity is estimated to be 648,000 gallons per day, with the capacity expanding to 1.2 million gallons per day. Under the Proposed Action, Site 300 would use 0.1 percent of the Hetch Hetchy water supply. Given the low population and rural character of the area, an indiscernible increase in water use under the Proposed Action, and the eventual Hetch Hetchy supply, no cumulative impacts to water availability for Site 300 and the vicinity would be expected.

The land surrounding Site 300 is designated as general agricultural, recreational, conservational, and wind resource areas (see Figure 4.2.1.2–1). Most of this land is agricultural, however, property immediately east of the site is occupied by a company that packages and stores

fireworks. The Carnegie State Vehicular Recreation Area, southwest of the site, is used for off-highway vehicles. Aside from the vehicular recreation area, which likely contributes to sediment runoff during rainstorms, the cumulative impact on surface water quality from activities in surrounding areas would be minimal. Because the area is largely undeveloped and expected to continue in that manner, no cumulative impacts to groundwater recharge would be expected.

Groundwater contamination at Site 300 has been restricted to within the site boundary and groundwater quality is improving through remediation activities. Because these plumes are the only known groundwater contamination in the Site 300 vicinity, no cumulative impacts to groundwater quality would be expected.

5.3.10 Noise

This section presents noise impacts resulting from implementation of the Proposed Action. The analysis is organized by noise-generating LLNL activities such as construction, modifications to and removal of facilities, traffic noise, and impulse noise.

5.3.10.1 *Relationship with Site Operations*

Activities associated with the Proposed Action (Section 3.3) would contribute to noise generation, either directly or indirectly. The general parameters that were used to characterize community noise levels under the Proposed Action are listed in Table 5.3.10.1–1.

5.3.10.2 *Impact Analysis*

The Proposed Action would be a continuation of current activities. There would be a number of new projects including facility upgrades, D&D activities, and new facility construction. The scope of activities under the Proposed Action would include all planned No Action Alternative activities, as well as several additional projects at both the Livermore Site and Site 300 and increased staffing requirements.

Modifications to Facilities or Operations

Noise generated during construction activities supporting facility and infrastructure renovations at the Livermore Site and Site 300 would not generally be noticeable in nearby communities, owing to the relatively large spatial area, perimeter buffer zone, and intervening roadways. However, because the Proposed Action would include a higher level of activity, about two to three times that planned under the No Action Alternative, there would be higher likelihood of a discernible impact in offsite areas. At most, during peak activity levels, a person located 100 feet from a noisy construction site would not be exposed to more than 82 dBA and for only limited periods of maximum activity. These levels are similar to the No Action Alternative, and no additional noise impacts are expected for the Proposed Action.

New facilities associated with the Proposed Action would be primarily offices and laboratories and would not introduce any machinery or equipment that would differ from the current HVAC equipment, cooling towers, motors, pumps, fans, generators, air compressors, and loudspeakers. Noise from this equipment would not be noticeable beyond the site boundary. No additional noise impacts are expected.

Livermore Site

At the Livermore Site, two near-fenceline construction projects, the Consolidated Security Facility and a Science and Education Lecture Hall near the West Gate, would have a higher likelihood of discernible impacts in areas offsite; however, even at their peak, these construction projects would not result in a community member being exposed to more than 82 dBA and that for only limited periods of maximum activity. These sources are not expected to be objectionable nor would they conflict with compatibility guidelines.

Site 300

Two construction projects would be included under the Proposed Action at Site 300. Construction activities would occur over a limited time and, other than construction-related vehicles accessing the site, would not result in a discernable impact to areas offsite.

Traffic Noise

The Proposed Action would result in a slight increase in heavy-duty vehicle activity at both the Livermore Site and Site 300, and a corresponding increase in the frequency of associated peak noise levels. Vehicles serving LLNL would be subject to requirements that they be properly muffled to reduce noise impacts, and activities would be limited to those times that would be less noticeable and less objectionable.

The Proposed Action would require a workforce increase, adding 500 employees at the Livermore Site by the year 2014, and a corresponding increase in vehicular activity. The additional traffic would add slightly to ambient noise levels, and would be a small increase from the No Action Alternative. To help alleviate this impact, LLNL would continue promoting and expanding its Transportation Systems Management Program to aid in providing viable alternatives to employee commuting, thereby reducing traffic congestion and noise (LLNL 2001s). Only incremental additions to the workforce, approximately 10 employees, would be required for Site 300; vehicular activity would be the same as under the No Action Alternative.

Impulse Noise

LLNL would continue explosives research testing under the Proposed Action at both the Livermore Site in the Building 191 High Explosives Application Facility, and at Site 300 within the Contained Firing Facility and on open firing tables. No additional noise impacts are expected. LLNL would continue to use blast forecasting as a tool to determine if explosive tests would adversely affect the surrounding community and to restrict operations when peak-impulse noise levels are predicted to exceed the 126-dBA level in populated areas. LLNL would also continue to perform meteorological monitoring to provide necessary input data for blast forecasting (LLNL 2001s). No additional noise impacts are expected.

Decommissioning, Decontamination, and Demolition

The Proposed Action would include the removal of 820,000 gross square feet of excess and legacy facilities. This is 456,456 square feet at the Livermore Site and 109,333 square feet at Site 300 greater than the No Action Alternative. Although this rate would be higher than that of recent years, with the relatively large spatial area and perimeter buffer zone, noise from demolition activities would not be discernible in offsite areas. No additional noise impacts are expected.

5.3.10.3 Cumulative Impacts

As stated, planned activities associated with the Proposed Action would include a projected increase in workforce, adding approximately 500 employees at the Livermore Site. Although the jobs that would be created under the Proposed Action represent a very small fraction (less than 1 percent) of the projected increase in employment within Alameda County and San Joaquin counties (described in Section 5.1.2), activities and services to support the relocated population would contribute to local noise levels, both short-term, in areas of increased construction activities, and long-term, associated with increased development, density of population and commercial activities, and vehicular traffic and congestion.

Local noise ordinances and restrictions on allowable noise levels, as stated in terms of land use compatibility guidelines for community noise environments (discussed in Section 4.12.1.2), would limit the impact of additional noise sources on the local community. The city of Livermore is currently working on several elements of its General Plan and may consider additional restrictions based on key findings related to noise (City of Livermore and LSA 2002). With Livermore's anticipated growth in the future, noise levels are expected to increase due to potential increases in Livermore's current key noise sources: construction activity, development,

vehicular activity, and rail and aviation operations. Noise levels from potential mixed use and infill development in Livermore, especially in the downtown, could exceed noise level guidelines as a result of land use incompatibilities.

5.3.11 Traffic and Transportation

Traffic congestion and the collective dose and LCFs to the general population from radiological shipments were analyzed. The estimate of traffic congestion is based on the change in employment under the Proposed Action compared to the No Action Alternative. Radiological consequences were calculated using DOE transportation models as described in Section 5.1.11. Appendix J presents more information on the methodology and important inputs for radiological transportation analysis.

5.3.11.1 Relationship with Site Operations

Section 3.3 describes the projects under the Proposed Action. These projects, when combined with the No Action Alternative, would result in increased radiological transportation. The major shipments in the Proposed Action would result in 300 shipments of special nuclear material, 82 shipments of LLW and MLLW, 5 shipments of tritium, and 9 TRU waste shipments in the maximum year (see Appendix J, Section J.5.3 for more details).

5.3.11.2 Impact Analysis

Livermore Site

Under the Proposed Action, site employment would increase from the No Action Alternative of approximately 10,650 to 11,150 personnel. This increase would affect traffic near the Livermore Site. Although construction employment would rise and fall over the period of analysis for this LLNL SW/SPEIS, the average contractor employment level (including construction and operations contract employees) at the Livermore Site would not vary significantly from the current level. Any variations in construction employment for the Proposed Action would be small, compared to overall site employment, and temporary. Under the Proposed Action, offsite transportation of radioactive materials would increase from that under the No Action Alternative. The impacts of bounding radiological transportation accidents are described in Section 5.5.5. Chapter 4, Section 4.13, describes the existing traffic and transportation levels.

Operations traffic would be comprised of commuting workers and deliveries of materials needed for the operation of the facilities. The number of new Livermore Site workers under the Proposed Action would be approximately 500, representing a 5 percent increase in the Livermore Site workforce. This is a small fraction of the current traffic level near LLNL, as described in Section 4.13. Traffic in the Tri-Valley Area is heavily congested. Although LLNL traffic contributes to this congestion, its overall percent contribution is small, and the incremental contribution from the Proposed Action over the No Action Alternative would be negligible; very small impacts would be expected.

The increase in the site workforce could also affect the availability of parking spaces. Site planners working under the Parking Master Plan (LLNL 2002bv) would ensure that newly constructed facilities would have adequate parking for the facility's workforce.

Under the Proposed Action, shipments of radioactive materials would increase over the No Action Alternative because of the additional projects described in Section 3.2 that require radiological shipments. However, because of the nature of the shipments, the radiological impacts would not increase. The shipments would include nuclear material, tritium, LLW, MLLW, TRU waste (including Berkeley drums), and miscellaneous radioactive materials (see Appendix J, Section J.5.3). Table 5.3.11.2–1 presents the collective dose under the Proposed Action. The number of LCFs for the Proposed Action would be much less than one (5×10^{-3}) per year.

TABLE 5.3.11.2–1.—Collective Dose to the General Public From Radioactive Shipments Under the Proposed Action

Shipment Type	Collective Dose (person-rem per year)			
	Along Route	Sharing Route	At Stops	Total
LLW	0.15	1.7	0.78	2.6
TRU waste	9.9×10^{-2}	1.2	0.55	1.9
Materials ^a	0.26	2.9	1.4	4.5
Total	0.51	5.8	2.8	9.0
No Action Alternative	0.42	4.7	2.2	7.4

^a Nonwaste radioactive materials, including special nuclear materials, tritium, and other materials used for the LLNL mission.
LLW = low-level waste; TRU = transuranic.

All radioactive materials would be shipped in certified containers and in accordance with U.S. Department of Transportation and DOE regulations. These regulations specify package integrity during normal transport and accident conditions, limit dose rate from the packages and vehicles, and specify special precautions for the more radioactive shipments, including operational procedures such as reduced speed limits, limited routes, special vehicle maintenance, and escort during transport.

Site 300

The Proposed Action would result in very small changes to the workforce at Site 300. Construction of the EMPC and the HEDC would create small and temporary increases in construction-related traffic. Site 300 does not engage in any significant transport of radioactive materials; however, explosives are often transported. Under the Proposed Action, the number of explosives shipments would not significantly increase from those under the No Action Alternative and very small incremental impacts are expected.

Operations traffic would comprise of commuting workers and deliveries of materials needed for the operation of the facilities. The number of new Site 300 workers under the Proposed Action would not be expected to increase over the No Action Alternative. Traffic in the Site 300 area is generally not heavy due to its rural location. Any incremental increase in traffic could be readily accommodated by the local road system and no impacts are expected.

5.3.11.3 Cumulative Impacts

Livermore Site

Traffic congestion in the Tri-Valley Area is very heavy and would likely increase due to growth in the area. Any increases in LLNL employment under the Proposed Action would, however small, contribute to this congestion. Because the contribution of the Proposed Action plus current LLNL traffic to the overall congestion problem would be small, detailed analysis of the cumulative impacts is not warranted. However, LLNL's contribution to radiological impacts near LLNL would not be a small percentage of overall radiological impacts. Therefore, this cumulative impacts analysis focuses on collective dose from radiological transportation. The analysis considers LLNL's radiological transportation cumulative with SNL/CA's radiological transportation.

A RADTRAN 5 analysis for 3.5 miles of highway near the Livermore area where all radiological shipments would converge were performed. The shipments were comprised of those in the Proposed Action (6.1×10^{-2} person-rem per year) and those from SNL/CA (1.2×10^{-3} person-rem per year). The resulting collective dose would be 6.2×10^{-2} person-rem per year, corresponding to 4×10^{-5} LCFs per year. Impacts are expected to be minimal. More information on the calculation is presented in Appendix J, Section J.7.

Site 300

Traffic between Corral Hollow Road and I-580, and along Tesla Road between the Livermore Site and Site 300, is strongly affected by Site 300 traffic during shift changes. Nevertheless, the Site 300 contribution would be small compared to the capacity of the roads. Local traffic could increase slightly over the years as pressures for residential and commercial development increase for land near Site 300. Residential areas are few and sparsely populated, although, a Tracy Hills residential development near the site has been planned for many years. Currently, the Carnegie State Vehicular Recreation Area along the southwest side of the site, across Corral Hollow Road, and private ranching operations are the only commercial operations near Site 300. Commuters on I-580 occasionally use Corral Hollow Road as an alternative route when I-580 is heavily congested. Any small increases in employment at Site 300 under the Proposed Action would have minimal impact on this overall traffic condition.

5.3.12 Utilities and Energy

This section discusses the potential impacts of the Proposed Action on utilities and energy supplies. Utility and energy usage are discussed separately for the Livermore Site and Site 300. LLNL-leased properties (i.e., Almond Avenue, Graham Court, Patterson Pass, and Arroyo Mocho Pump Station) are considered part of the Livermore Site in assessing utility and energy impacts.

5.3.12.1 Relationship with Site Operations

This section summarizes the relationship between projects described in Section 3.3 for the Proposed Action and the utilities and energy analysis. In general, the effects of projects for the Proposed Action on utilities and energy analyses are related to water consumption, sewer

discharges, electricity consumption, and fuel consumption resulting from design, construction, and operation of projects.

As discussed in Section 5.1.12, the utilities and energy analysis is based on projected square footage requirements and available system capacities. Under the Proposed Action, total facility space at the Livermore Site would decrease approximately 1.0 percent from the projections under the No Action Alternative, and total facility space at Site 300 would remain the same as that projected under the No Action Alternative. A number of facility and utility system upgrades are also planned under the Proposed Action. The impact categories for the utilities and energy analysis are discussed in depth in the following sections.

5.3.12.2 Impact Analysis

Water Consumption

Livermore Site

Under the Proposed Action, the Livermore Site would experience a 1.0 percent decrease in facility space and a corresponding decrease in water consumption from the No Action Alternative. Annual water consumption at the Livermore Site is estimated to be approximately 276 million gallons per year under the No Action Alternative (see Section 5.2.12.3). Annual water consumption under the Proposed Action is projected to decrease to approximately 273 million gallons per year. Peak water use at the Livermore Site would be the same as under the No Action Alternative, approximately 1.37 million gallons per day. The existing capacity of the Livermore Site domestic water system is approximately 2.88 million gallons per day. Because the Livermore Site domestic water system has adequate capacity to meet future water demand under this alternative, impacts would be minimal.

Site 300

Site 300 is supplied with water from a system of wells. The existing capacity of usable wells is approximately 930,000 gallons per day. A project to connect Site 300 with water pumped from the city of San Francisco's Hetch Hetchy water supply system is expected to be complete by early 2004. The capacity of this new water supply is estimated to be 648,000 gallons per day, with the capability of expanding to 1.2 million gallons per day (LLNL 2000a). Average water consumption at Site 300 is 67,900 million gallons per day (LLNL 2003aq). Under the Proposed Action, NNSA would demolish approximately 129,500 square feet of obsolete building space and replace it with an equal amount of modern building space. Therefore, the No Action Alternative water use at Site 300 is considered to be representative of future consumption rates for the Proposed Action. No new impacts are expected.

Sewer Discharges

Livermore Site

An increase in the volume of sewage discharges would result from implementation of the Proposed Action at the Livermore Site. The Livermore Site would discharge approximately 224,000 gallons of sewage per day under the No Action Alternative (see Section 5.1.12.3). Under the Proposed Action, sewage production would decrease by 1.0 percent to approximately 222,000 gallons per day. The LWRP currently receives a total of approximately 6.5 million gallons of effluent per day. The capacity of this facility is 8.5 million gallons of effluent per day, which is expected to be sufficient for inflow treatment for the next 10 years. Impacts from this increase in sewer discharges from the Livermore Site would be minimal.

Site 300

Site 300 sanitary sewage generated outside the GSA is disposed of through septic tanks and leachfields or cesspools at individual building locations. Sanitary sewage generated within the GSA is piped into an asphalt membrane-lined oxidation pond east of the GSA.

Under the No Action Alternative, Site 300 discharges approximately 2,100 gallons of sewage per day. Under the Proposed Action, NNSA would demolish approximately 129,500 square feet of obsolete building space and replace it with an equal amount of modern building space. Therefore, the No Action Alternative sewage discharge rates at Site 300 are considered to be representative of future consumption rates for the Proposed Action. No offsite sewage treatment is conducted for Site 300 wastes, therefore no impacts are expected.

Electricity Consumption

Livermore Site

The projected peak electrical demand under the Proposed Action would be 81 megawatts. The current system capacity is 125 megawatts. Growth at the Livermore Site would result in increased electricity consumption. This would have an impact on electrical power supply and distribution systems. The Livermore Site would consume approximately 446 million kilowatt-hours per year under the No Action Alternative. Under the Proposed Action, electric power consumption is expected to decrease by 1.0 percent to approximately 442 million kilowatt-hours per year. The LLNL distribution system and existing capacity for the utilities to supply energy on both a total and a peak load basis would adequately meet the projected increase in consumption, but may limit future development at the site.

Site 300

Electricity consumption at Site 300 decreased from an average of 21.75 million kilowatt-hours per year in 1992 to approximately 16.3 million kilowatt-hours per year (LLNL 2003aq). Electricity consumption at Site 300 has remained stable over the past 5 years.

Under the Proposed Action, NNSA would demolish approximately 129,500 square feet of obsolete building space and replace it with an equal amount of modern building space. Therefore, No Action Alternative electrical power consumption at Site 300 is considered to be representative of future consumption rates for the Proposed Action. No new impacts are expected.

Fuel Consumption

Livermore Site

PG&E supplies natural gas to the Livermore Site. Natural gas consumption for the Livermore Site would average 23,300 therms per day under the No Action Alternative. Based on the projected increase in gross square footage of developed space at the Livermore Site, fuel consumption under the Proposed Action would decrease by 1.0 percent to approximately 23,000 therms natural gas per day. This would result in minimal impact upon supply.

There is no planned change in diesel fuel or unleaded gasoline use for the Proposed Action. Consumption of approximately 72,200 gallons diesel fuel per year and 451,800 gallons unleaded gasoline per year is anticipated.

Site 300

Under the No Action Alternative, Site 300 fuel oil consumption is approximately 16,600 gallons per year (LLNL 2003aq). Under the Proposed Action, NNSA would demolish approximately 129,500 square feet of obsolete building space and replace it with an equal amount of modern building space. Therefore, fuel oil consumption under the No Action Alternative is considered to be representative of future consumption rates for the Proposed Action.

5.3.12.3 Cumulative Impacts

Water Consumption

Livermore Site

The Proposed Action together with other developments in the Hetch Hetchy service area would increase demand for and consumption of water. For example, the population in Alameda County is projected to increase by about 17 percent by the year 2015 (DOF 2001). Residential, commercial, industrial, and other uses in Alameda County are expected to increase proportionally. Other counties in the Hetch Hetchy service area would experience similar growth. This population growth in the Hetch Hetchy service area in conjunction with water use at the Livermore Site would constitute a cumulative impact upon water resources and supply systems.

Site 300

Current water use at Site 300 is considered to be representative of future consumption rates for the Proposed Action. However, development in the vicinity of Site 300 would increase demand for and consumption of water. Population in San Joaquin County is projected to increase by 30

percent by the year 2015 (DOF 2001). Residential, commercial, industrial, and other water demands in San Joaquin County are expected to increase proportionally. This population growth would constitute an adverse cumulative impact on groundwater resources. Similarly, population growth within the Hetch Hetchy service area in conjunction with water use at Site 300 would constitute an impact upon water resources in the Hetch Hetchy service area.

Sewer Discharges

Livermore Site

The Proposed Action together with other developments in the area would increase demand for sewage services. Population in Alameda County is projected to increase by about 17 percent by the year 2015 (DOF 2001). Residential, commercial, industrial, and other uses in Alameda County are expected to increase proportionally. This growth in conjunction with sewer discharges from the Livermore Site would constitute a cumulative impact on sewage systems in the area. The LWRP currently receives approximately 6.5 million gallons of effluent per day. While existing LWRP capacity of 8.5 million gallons per day is expected to be sufficient for inflow treatment for the next 10 years, sewage treatment facility improvements are being planned in the region.

Site 300

Because Site 300 sewer discharge and treatment programs are mostly self-contained, no cumulative impact is expected as a result of the Proposed Action.

Electricity Consumption

Livermore Site

The projected peak electrical demand under the Proposed Action would be 81 megawatts. The Proposed Action together with other developments in the area would increase electric power demand. Population in Alameda County is projected to increase by about 17 percent by the year 2015 (DOF 2001). Residential, commercial, industrial, and other uses in Alameda County are expected to increase proportionally. This growth in conjunction with the demand for electrical power at the Livermore Site could constitute a cumulative impact on electric power resources in the area. Currently, electric utilities provide approximately 10,605 million kilowatt-hours per year of electricity to Alameda County (CEC 2001). However, more than 10,000 megawatts of new electric generation capacity is planned in the PG&E service area, which includes Alameda County. Additional generating capacity is planned throughout California and surrounding states (CEC 2000). Expanded electric transmission capability is also planned in the region. If implemented as planned, these additions would provide sufficient capacity to meet Alameda County electrical energy needs for the next 10 years. Therefore, any impact would be mitigated.

Site 300

Current electric power consumption at Site 300 is considered to be representative of future consumption rates for the Proposed Action. However, the population in San Joaquin County is projected to increase by 30 percent by the year 2015 (DOF 2001). Residential, commercial,

industrial, and other electric power uses in San Joaquin County are expected to increase proportionally. This growth could constitute a cumulative impact on electric power resources in the area. Currently, electric utilities provide approximately 5,106 million kilowatt-hours per year of electricity to San Joaquin County (CEC 2001). However, more than 10,000 megawatts of new electric generation capacity is planned in the PG&E service area, which includes San Joaquin County. Additional generating capacity is planned throughout California and surrounding states (CEC 2000). Expanded electric transmission capability is also planned in the region. If implemented as planned, these additions would provide sufficient capacity to meet San Joaquin County electrical energy needs for the next 10 years. Therefore, any impacts would be mitigated.

Fuel Consumption

Livermore Site

The Proposed Action together with other developments in the PG&E service area would increase the demand for natural gas. Population in Alameda County is projected to increase by about 17 percent by the year 2015 (DOF 2001). Residential, commercial, industrial, and other uses in Alameda County are expected to increase proportionally. This growth could constitute a cumulative impact on fuel supply systems. However, PG&E's transmission capacity is approximately 130 percent of the demand for natural gas in its service area (CPUC 2001). As required by the California Public Utilities Commission, PG&E uses a 15-year planning horizon for gas transmission and storage capacity and a 10-year planning horizon for local gas distribution systems. Accordingly, PG&E plans to provide sufficient capacity to meet Alameda County needs for the next 10 years. Diesel fuel and unleaded gasoline delivery systems in Alameda County are adequate and sufficient to meet fuel requirements for the next 10 years. Therefore, any impacts would be mitigated.

Site 300

Current fuel oil consumption at Site 300 is considered to be representative of future consumption rates for the Proposed Action. However, the population in San Joaquin County is projected to increase by 30 percent by the year 2015 (DOF 2001). Fuel oil use in San Joaquin County is expected to increase as the population increases, but at a lower rate. This growth could constitute a cumulative impact on fuel oil supplies in the county. Overall fuel oil use in California has declined substantially as air quality regulations concerning greenhouse gas emissions become more stringent. Consequently, fuel oil delivery systems within San Joaquin County have large amounts of excess capacity sufficient to meet San Joaquin County requirements for the next 10 years. Therefore, any impacts would be mitigated.

5.3.13 Materials and Waste Management

5.3.13.1 *Materials Management*

This section provides an overview of management responsibilities regarding receipt, transfer, and shipment of radioactive, controlled, and hazardous materials at LLNL under the Proposed Action. Appendices A, B, D, M, and N of this LLNL SW/SPEIS include descriptions of programs and buildings associated with use of these materials. The use of these materials historically has resulted in their planned and inadvertent releases to the environment.

The consequences of using radioactive, controlled, and hazardous materials are discussed in the sections associated with the affected media. For example, releases to the air associated with use of radioactive materials are discussed in Section 5.3.9, and releases affecting vegetation are discussed in Section 5.3.8. The workplace use of these materials and associated occupational exposures are discussed in Section 5.3.14.

Relationship with Site Operations

Several new operations are currently in the planning stages at LLNL. However, they were considered outside of the scope of the existing conditions for this LLNL SW/SPEIS because they had not yet reached operational status. New operations are defined as programmatically planned projects with implementation schedules that will take place in the future (e.g., the NIF). In general, material usage at LLNL would increase, consistent with a 7 percent increase in LLNL operations above the No Action Alternative.

Under all conditions, existing waste minimization and pollution prevention techniques would be expected to offset a portion of the projected increase. Average maximum quantities would likely remain constant as material storage space remains constant; however, average quantities would be expected to increase to meet demand. Under the Proposed Action, material projections used for analysis would not exceed existing material management capacities.

Impact Analysis

The Proposed Action would not cause any major changes in the types of materials used onsite. Material usage at LLNL would increase, consistent with a 7 percent increase in laboratory operations above the No Action Alternative. However, existing waste minimization and pollution prevention techniques would offset a portion of the projected increase. Average maximum quantities would likely remain constant as material storage space remains constant; however, average quantities would be expected to increase to meet demand. Under the Proposed Action, material projections used for analysis would not exceed existing material management capacities.

Existing Operations

The Proposed Action total hazardous material usage would increase for existing facilities. Under the Proposed Action, average quantities would increase by an estimated 7 percent (Table 5.3.13.1–1) above the No Action Alternative. Annually, approximately 183,000 to 204,000 chemical containers, ranging from 210-liter (55-gallon) drums to gram-quantity vials, would be used or stored at LLNL.

Annually, for the Livermore Site, approximately 75,000 gallons of liquids would be managed under the Proposed Action with an estimated storage capacity of 227,000 gallons. Approximately 1.5 million pounds of solids would be handled with a storage capacity of 2.4 million pounds. Solid material storage would not be expected to fluctuate because metals (e.g., lead used for shielding) would be less likely to be consumed and more likely to be reused and reclaimed. Regardless, there would be sufficient capacity to accommodate anticipated operations. Approximately 1.2 million cubic feet of mostly industrial gases (argon, helium, hydrogen, oxygen, nitrogen) would be used annually with a storage capacity 71.6 million cubic feet.

**TABLE 5.3.13.1–2.—List of Hazardous Chemicals for Use at Site 300
Under the Proposed Action**

Chemical	Chemical Abstract Number	No Action Average Maximum/Average Quantity	Proposed Action Maximum/Average Quantity
Paints/Solvents			
Paint (variety)	NA	7,200/1,230 lb	7,200/1,300 lb
Thinner, lacquer	NA	310/125 gal	310/105 gal
Methyl alcohol	67-56-1	90/5 gal	90/5 gal
Acetone	67-64-1	400/35 gal	400/30 gal
Metals (No changes are expected)			
Lead bricks or ingots	NA	25,000 lb	25,000 lbs
Acids/Bases/Oxidizers			
Oxygen, compressed	7782-44-7	16,000/5,150 ft ³	16,000/5,500 ft ³
Sulfuric acid	7664-93-9	845/62 lb	845/70 lb
Cyanuric acid	108-80-5	500/52 lb	500/55 lb
Industrial Gases			
Argon, compressed	7440-37-1	30,000/30,000 ft ³	30,000/33,000 ft ³
Helium	7440-59-7	25,000/25,800 ft ³	25,000/27,500 ft ³
Hydrogen, compressed	1333-74-0	700/720 ft ³	700/770 ft ³
Nitrogen, compressed (Liquified, gaseous)	7727-37-9	312,000/288,000 ft ³	312,000/310,000 ft ³
Carbon dioxide	124-38-9	44,000/5,200 ft ³	44,000/5,500 ft ³
Refrigerants			
Freon 113 (1,1,2-Trichloro-1,2,2-trifluoroethane)	76-13-1	150/10 gal	150/10 gal
Freon 22 (Chlorodifluoromethane)	75-45-6	1,400/910 lb	1,400/950 lb
Freon 12 (Dichlorodifluoromethane)	75-71-8	660/230 lb	660/240 lb
Freon 13 (Chlorotrifluoromethane)	75-72-9	478/478 ft ³	478/478 ft ³ (No change)
Freon 14 (Tetrafluoromethane)	75-73-0	2,000/515 ft ³	2,000/550 ft ³

Source: LLNL 2002m, TtNUS 2003.

Note: Numbers are rounded. Additional chemicals are listed in Appendix B.

ft³ = cubic feet; gal = gallons; lb = pounds; NA = not available.

Projections for specific hazardous chemicals for existing Livermore Site operations and Site 300 operations under the Proposed Action are presented in Tables 5.3.13.1–1 and 5.3.13.1–2, respectively. Additional detail is provided in Appendix B.

Increases in overall radioactive materials and explosive materials based on current administrative limits would be expected. Overall, no additional storage handling capacity, regulatory requirements, or security requirements would be needed. Under the Proposed Action, radioactive material and explosive material requirements used for analysis would not exceed existing material management capacities (TtNUS 2003). No new impacts are expected.

New Operations

LLNL anticipates hazardous material usage rates to increase over the next 10 years. The majority of the increase would be due to the full implementation of the NIF and the BSL-3 operations

(Table 5.3.13.1–3). New LLNL operations would account for approximately 70,000 gallons of liquids and solids and approximately 20,000 standard cubic feet of industrial gases). Materials that would be expected to support other projects, including the new Office of Science Laboratories and typical D&D projects, are described in Tables 5.3.13.1–3 and 5.3.13.1–4. For new facilities, no impacts would be expected because each of the new facilities would be designed to handle expected quantities.

TABLE 5.3.13.1–3.—Types of Hazardous Materials in Use with New Operations Under the Proposed Action

Project Title	Hazardous Materials Expected
Increased Administrative limits for plutonium in Superblock	Plutonium limits increased.
Energetic Materials Processing Center	Explosives, other explosive materials, solvents, acids, bases, other chemicals. Project replaces existing operations at Site 300 (see general information in Table 5.3.13.1.2–2)
Increase in Tritium Facility material limits	Tritium increases
Materials Science modernization project	Materials would be similar to those at existing Materials Science facilities
High Explosives Development Center	Explosives, other explosive materials, solvents, acids, bases, other chemicals. Project replaces some existing operations at Site 300 (see general information in Table 5.3.13.1.2–2)
Berkeley waste drums	No materials associated with this project
Increased worker population	Included in Table 5.3.13.1.2–1
Use of court-ordered materials at NIF	Plutonium targets and other materials (See Appendix M)
Petawatt laser prototype	No new materials
Building 696 Mixed Waste Permit	Limited materials, primary function would be waste management
Deactivation and D&D projects	Limited materials, primary function would be D&D
Increase MAR for Superblock	No new materials; only MAR increase
NIF Neutron Spectrometer	No new materials
CBNP expansion	Small samples of RG-1 and RG-2 nonselect biological agents
Consolidated Security Facility	No new materials
Waste management	Waste management activities only
Building 625 waste storage	Waste management activities only
Direct shipment of TRU from plutonium facility	Waste management activities only
Building utilities upgrade	No new materials
Building seismic upgrades	No new materials

Source: TtNUS 2003.

CBNP = Chemical and Biological National Security; D&D = decontamination and decommissioning; MAR = material-at-risk; NIF = National Ignition Facility; TRU = transuranic.

TABLE 5.3.13.1–4.—Listing of Materials for Use with Decontamination and Decommissioning, Construction, Upgrades, and Other Improvements Under the Proposed Action^{a, b, c}

Material Usage Description
Acoustical ceiling, acoustical insulation, acrylic, additives, adhesives, asphalt, bonding agent, carpet and padding, caulking, ceramic, cleaners, concrete, coolants, fillers, glazing, glues, gypsum wallboard, insulating paints, insulation, joint compounds, latex, metal ceiling, oils, paints, pipes, primer, putties, quarry and conductive tile, reducers, roofing materials, sealants, sealer, soil, solder, solvents, spackling, sprayed fireproofing, structural metals, tile grout, tubes, wallpaper supplies, waterproofing, wiring, and wood finishing.

Source: TtNUS 2003.

^a Examples of D&D projects include Buildings 808, 412, 175N, 212, 251, 419, 171.

^b Examples of construction projects include Office of Science Lab, EMPC, and other new buildings listed in Table 5.3.13.1–3.

^c Examples of Upgrades include building utilities, seismic, site utilities upgrades.

D&D = decontamination and decommissioning; EMPC = Energetic Material Processing Center.

Along with the projects identified under the No Action Alternative (see Section 5.2.13.1), the Proposed Action would include four construction projects, nine D&D projects, five miscellaneous projects, six renovation/modernization/consolidation projects, and six new operations (see Appendices A and B for additional details). Site material usage would increase because of the new operations. Overall radioactive materials and explosive materials, based on current administrative limits, would increase. Under the Proposed Action, radioactive material and explosive material requirements used for analysis would not exceed material management capacities.

Cumulative Impacts

The ROI for materials management involves LLNL and its facilities as presented in Chapter 4 of this LLNL SW/SPEIS. The ROI for cumulative impacts is larger than that presented in Chapter 4 and considers the contributions of LLNL (Livermore Site and Site 300), SNL/CA, local projects and activities, and the State of California. Where appropriate, qualitative information has been provided in tabular form.

Livermore Site

Under the Proposed Action, approximately 183,000 to 204,000 chemical containers, ranging from 210-liter (55-gallon) drums to gram-quantity vials, would be used or stored at LLNL annually. For the Livermore Site, approximately 75,000 gallons of liquids would be managed with an estimated storage capacity of 227,000 gallons (remaining capacity of 67 percent) annually. Approximately 1.5 million pounds of solids would be handled with a storage capacity of 2.4 million pounds (remaining capacity of 38 percent). Solid material storage would not be expected to fluctuate because metals (e.g., lead used for shielding) would less likely be consumed and more likely be reused and reclaimed. Regardless, there would be sufficient capacity to accommodate anticipated operations. Approximately 1.2 million cubic feet of mostly industrial gases (argon, helium, hydrogen, oxygen, nitrogen) would be used annually with a storage capacity of 71.6 million cubic feet. Table 5.3.13.1–5 lists some commonly used chemicals at LLNL.

TABLE 5.3.13.1–5.—Commonly Used Chemicals at Lawrence Livermore National Laboratory^a

Hazardous material	Quantity in Pounds
Paints (varies assumed 1-2% glycol ethers)	8,000
Sulfuric acid	5,016
Hydrochloric acid	3,500
Toluene	3,500
Methanol	700

Source: TtNUS 2003.

^a The commonly used chemicals listed above were derived during comparisons of chemicals reported in LLNL, EPA, and DOE databases.

LLNL uses explosives in various R&D and test applications. Explosive quantities used per activity range from milligrams to several kilograms. Overall, the quantities of explosive material maintained onsite are restricted by the approved explosive capacity of various storage areas. No increases in storage capacity were projected.

Sandia National Laboratories/California

SNL/CA maintains a small inventory of radioactive materials used in laboratory and radiation monitoring activities. All radioactive material used by SNL/CA is obtained from offsite sources. Individual sources at SNL/CA generally have small quantities of radioactive material and most are sealed. Radioactive material inventories are maintained at mission-essential levels, and all attempts are made to reduce inventories of surplus legacy material. No increases in radioactive material would be expected since most radioactive sources are sealed and not consumed (NNSA 2003a).

Like LLNL, SNL/CA uses a wide variety of chemicals in small-scale laboratory operations. Using the Maximum Operations Alternative from the January 2003 *Final Site-Wide Environmental Assessment of SNL/CA Environmental Information Document* and projecting a 53 percent increase in operations, more than 12,000 different chemicals would be in use or stored at SNL/CA at any given time in more than 52,000 different containers.

SNL/CA uses explosives in various R&D and test applications. Explosive quantities used per activity range from milligrams to several kilograms. Overall, the quantities of explosive material maintained onsite are restricted by the approved explosive capacity of various storage areas. No increases in storage capacity were projected.

California (including Alameda and San Joaquin Counties)

Annually, over 340 million tons of hazardous materials are used in California. The EPA online Toxics Release Inventory (TRI) database was queried for specific materials (indirectly related to release) in California. The data extracted are presented in Table 5.3.13.1–6. In 2000, over 178 hazardous materials totaling 77.5 million pounds were managed.

TABLE 5.3.13.1–6.—Toxics Release Inventory Database

Hazardous Material	Quantity in Pounds
Top Five	
Asbestos (friable)	8,312,561
Aluminum oxide (fibrous forms)	4,257,079
Lead compounds	4,479,859
Zinc compounds	4,042,183
Methanol	3,905,599
Other Chemicals	
Glycol ethers	3,184,791
Hydrochloric acid	1,085,636
Sulfuric acid	853,968
Xylenes	616,644
Total of over 178 materials	77.5 million pounds

Source: TiNUS 2003.

Note: In Alameda County, 59 materials totaling 3.76 million pounds were released. In San Joaquin County, 46 chemicals totaled 1.5 million pounds.

In general, LLNL manages less than 1 percent of hazardous material used in California. For example, LLNL uses 0.35 percent of the hydrochloric acid used in California. Similarly, LLNL uses 0.59 percent of sulfuric acid. Overall, LLNL hazardous material use would not result in critical shortages or other cumulative impacts.

5.3.13.2 Waste Management

This section provides an overview of management responsibilities for generation, storage, treatment, and disposal of radioactive, hazardous, mixed, and other wastes, including biohazardous and D&D wastes at LLNL under the Proposed Action. Appendices B, M, and N include a description of wastes and facilities associated with the use, generation, and analyses of these wastes.

Relationship with Site Operations

In general, waste generation increases proportionately from the No Action Alternative to the Proposed Action.

Waste minimization and pollution prevention techniques would offset a portion of the projected increases. Under the Proposed Action, waste generation projections used for analysis would not exceed existing waste management capacities.

Impact Analysis

Implementation of the Proposed Action would not cause any major changes in the types of waste streams generated onsite. No additional waste storage, treatment, handling capacity, regulatory requirements, or security requirements would be needed. Although increasing over current conditions, waste generation levels over the next 10 years at LLNL would remain essentially consistent with recent generation quantities experienced during 1993 to 2002. Annually, any increase would be consistent with increases from new operations and normal fluctuations as previously noted. Waste minimization and pollution prevention techniques would be expected to

offset a portion of the projected increases. Between 1993 and 2002, overall (routine and nonroutine) TRU waste, LLW, MLLW, and hazardous waste generation, as reported by DOE, were reduced by 91, 57, 89, and 57 percent, respectively (DOE 2002s). Onsite waste handling capacities are four to five times the expected waste volumes. Waste projections used for analysis would not exceed existing offsite waste management disposal capacities. Wastes associated with existing operations, new operations, and special operations are presented below, including other wastes.

The Proposed Action would include all new operations, D&D projects, and other activities, including permit modifications and RCRA closures, identified in the No Action Alternative. See Section 5.2.13.2 for a list of activities under the No Action Alternative. The Proposed Action differs from the No Action Alternative in:

- Generation of routine waste quantities presented in Table 5.3.13.2–1
- Generation of nonroutine waste quantities presented in Table 5.3.13.2–1
- Generation of wastes associated with new operations presented in Table 5.3.13.2–2
- Additional permit modifications as discussed below

Existing Operations

For projection purposes, the CY1993 to CY2002 routine waste generation data were considered a reasonable range for existing facilities (existing operations); an average of these years was used. The amount of waste generated from existing operations would reflect proportional increases in LLNL activity levels. A margin (standard deviation) was added to differentiate the Proposed Action, account for normal fluctuations experienced since 1992, and bound any operational increases. The waste quantities projected represent a site-wide (Livermore Site and Site 300) aggregate of quantities for each type of waste category. Table 5.3.13.2–1 presents existing operations that are included in the estimated annual (routine) waste generation quantities by waste category. Current waste management infrastructure is adequate to manage this waste.

New Operations

New operations (including project-specific information) wastes would be derived from mission-related work. The waste quantities projected represent a site-wide aggregate of quantities for each type of waste category and are included in routine projections included in Table 5.3.13.2–1. Table 5.3.13.2–2 presents qualitative and quantitative waste information for each new operation. Existing waste management infrastructure can accommodate the predicted waste quantities.

Special (Nonroutine) Operations

Special (nonroutine) operations wastes are a result of special, limited duration projects such as construction that are considered separate from facility operations. Special, limited duration wastes include those generated from construction, demolition, D&D activities, and environmental restoration. The amount of waste generated would reflect proportional increases in LLNL activity levels for the foreseeable future. The waste quantities projected represent a site-wide aggregate of quantities for each type of waste category and are included in Table 5.3.13.2–1. Table 5.3.13.2–2 presents additional qualitative and quantitative waste information for each D&D and construction project.

All Other Wastes

LLNL operations involve the five additional waste management activity areas discussed below.

Biohazardous (includes Medical Waste Management Act) Waste

In 2002, several hundred pounds of medical wastes were disposed of at an approved offsite facility. Under the Proposed Action, biohazardous waste generation would increase by 7 percent. The existing waste handling capabilities would be adequate to accommodate this waste. No offsite impacts would occur because offsite disposal capacity would continue to be sufficient.

Construction and Decontamination and Decommissioning Waste

To bound impacts, this analysis assumed the construction of 100,000 to 200,000 square feet of new facilities, including specific projects listed in Table 5.3.13.2–2. This would generate 200 to 400 metric tons of construction debris. Approximately two-thirds of wood, concrete, asphalt, soil, metal, and cardboard would be diverted for recycling or reuse (LLNL 2002cc). The existing waste handling capabilities would be adequate to accommodate this waste. No additional offsite impacts would occur because offsite disposal capacity would continue to be sufficient.

With approximately 820,000 square feet of excess facilities to bound impacts, this analysis assumed the removal of all excess facilities. This would generate approximately 4,920 metric tons of debris (600 metric tons per 100,000 square feet). Only 350 metric tons would be of the LLW, MLLW, and hazardous waste variety. Approximately two-thirds of the debris total would be diverted, recycled, or reclaimed (LLNL 2002cc). The existing waste handling capabilities would be adequate to accommodate the remaining waste. No new offsite impacts would occur because offsite disposal capacity would continue to be sufficient.

Environmental Restoration Waste

Site-wide environmental restoration waste generation trends at LLNL would generally remain a function of treatment units, the number of wells, and the number of hours of operation. Existing waste handling capabilities are already in place.

Explosive Wastes

The Explosives Waste Treatment Facility would handle 2,800 to 3,000 pounds per year of explosive wastes. Explosives Waste Storage Facility would store (gross) 6,000 to 7,200 pounds per year. This represents a 7 percent increase over No Action. No additional capacity would be required.

Wastewater

Wastewater would increase to approximately 330,000 gallons per day. The current capacity of 1.69 million gallons per day (or 80 percent remaining capacity) would be adequate to accommodate this waste. Offsite disposal capacity would continue to be sufficient.

Permit Modifications, RCRA Closures, Permit Renewal, and Other Planned Activities

The Proposed Action includes all permit modifications, RCRA Closures, and a permit renewal identified in the No Action Alternative (see Section 5.2.13.2 for a list of activities under the No Action Alternative). The Proposed Action differs from the No Action Alternative in that it includes:

- Submit 100 Class 1 permit modification requests (may include more than one item per submittal) over the next 10 years (see Appendix B for details).
- Submit approximately 10 to 20 Class 2 permit modification requests (may include more than one item per submittal) over the next 10 years (see Appendix B for details).
- Submit approximately 1 to 2 Class 3 permit modifications over the next 10 years (see Appendix B for details).
- Obtain RCRA Part B permit for Building 696 operations.
- Relocate a 3,000-cubic-foot-liquid storage capacity at Building 696.
- Begin storage of hazardous and mixed wastes in Building 696.

These changes would enhance existing operations and would likely result in beneficial environmental impacts through improved technology and efficiency.

Cumulative Impacts

The ROI for waste management involves LLNL and its facilities as presented in Chapter 4 of this LLNL SW/SPEIS. The ROI for cumulative impacts is larger than that presented

in Chapter 4 and considers the contributions of LLNL (Livermore Site and Site 300), SNL/CA, NNSA, local projects and activities, and the State of California.

The waste generation impact of the Proposed Action would be larger than impacts of FY2002 operations, but still generally small, as compared to DOE/NNSA operations nationally or total wastes in California annually. For radioactive waste, LLNL would generate 99 percent of NNSA operations locally (or 1,700 cubic meters) and approximately 4 percent of DOE/NNSA operations nationally (or 40,000 cubic meters per year). SNL/CA would generate 10 cubic meters of LLW per year and 118 tons of hazardous waste per year. For hazardous waste, LLNL generation (1,365 metric tons) would only be 0.31 percent of total generation within California (427,302 tons hazardous waste). For municipal solid waste, the EPA determined that California has more than 10 years of remaining landfill capacity. NNSA recognizes landfill space can have a cumulative impact; however, land disposal would not result in critical shortages.

5.3.14 Human Health and Safety

5.3.14.1 Nonradiological Health Impacts

Operations at LLNL involve a wide range of activities with the potential for exposures of involved and noninvolved workers and the public to hazardous materials or conditions. These hazards include non-ionizing radiation, chemicals, biological agents, and industrial hazards. Evaluation of occupational protection issues considered existing ES&H programs that specifically address worker and general population protection measures implemented to control, reduce, or eliminate operational hazards. Hazardous chemicals to which involved and noninvolved workers could potentially be exposed, under the Proposed Action at the Livermore Site and Site 300, are listed in Table 5.3.13.1–1 and Table 5.3.13.1–2, respectively.

Relationship with Site Operations

Section 3.3 describes projects under the Proposed Action, that when combined with the No Action Alternative and current operations would result in a moderate increase in chemical inventories. There would also be an increase in construction and demolition activities associated with site facility expansion and renovation due to new missions and facility demolition and removal activities. These activities represent an increase in potential injuries associated with construction safety hazards.

Impact Analysis

The Proposed Action would not cause any major changes in the types of occupational, toxic, or physical hazards encountered by site personnel. Material usage at LLNL would increase. For purposes of this LLNL SW/SPEIS, it was assumed that the net percentage increase in laboratory operations would be accompanied by an increase in the amounts of hazardous substances used and stored onsite. However, as the mix of site missions shifts from chemical to mechanical and technological processes (i.e., computer modeling, computational research, etc.), the proportional increase in chemical inventories associated with new operations would be lessened.

Overall site usage of toxic substances and physical hazards would increase under the Proposed Action as activity levels increase at existing facilities and as new facilities are constructed and

begin operation. However, this would not represent an adverse impact. Under the Proposed Action, the use of additional quantities of chemicals would result in a slight increase in worker exposures. Facility improvements and additions would result in improved control measures for handling hazardous chemicals and controlling physical hazards. Worker exposure to hazardous chemicals would be minimized by the use of improved facilities for handling toxic chemicals and controlling physical hazards, such as the EMPC. Continued application of site ES&H and ISMS principles would result in minimal impacts to workers and the public.

LLNL has strict safety guidance and procedures in place. The site injury and illness rates have been declining as a result. Therefore, an increase in construction, demolition, and renovation activities that would occur under the Proposed Action would not significantly increase site injury and illness rates.

Based on the assumption that the increase in facility operations associated with the Proposed Action would represent an increase in chemical inventory, worker exposures would slightly increase. Facility upgrades and continued implementation of the site ES&H Program components would significantly reduce the risk of personnel exposures. Several proposed projects would result in increased levels of protection for both workers and the public. These would include:

- Building 151 upgrade
- Building 331 renovation and modification
- Building 332 ductwork replacement
- EMPC operations consolidation
- Building utilities upgrade
- Site utilities upgrade

Ongoing and proposed D&D activities would reduce overall site hazards by removing chemical and physical hazards from the workplace. These facilities would include:

- U235 cooling tower
- Building 514
- Building 419
- Building 412
- Building 171
- Building 175 north section
- Building 194 line-of-flight tube

- Building 212 ITC Accelerator Building
- Building 251

The proposed infrastructure improvements, such as roof replacements, facility renovations and facility and system upgrades, improve the overall safety envelope for the site. The proposed structural and seismic upgrades would result in improved facilities and work areas. Facility roof replacement would provide protective measures for sensitive facility components and increase the protection of potentially hazardous areas from exposure to the environment. Electrical and ventilation upgrades would increase facility control features and reduce the risk of hazardous energy events. Therefore, the reduction of impacts from these proposed activities would be beneficial.

Relocation of some existing explosives operations to the EMPC would consolidate higher hazard activities in a compliant facility. Likewise, the consolidation of operations currently conducted in Buildings 825, 826, and the Building 827 Complex into the planned HEDC would provide a similar increase in process and worker safety. Improvements could reduce worker exposure to chemicals and physical hazards relative to the facilities that are currently being used. This would represent a reduction in impacts and could be beneficial.

Cumulative Impacts

The occupational health and safety of workers at LLNL is site-specific and would not be affected by other activities occurring within the area. Cumulative effects for workers would be the same as those presented in the Proposed Action impact analysis above.

5.3.14.2 Radiological Health Impacts

This section analyzes the radiological health impacts from Proposed Action operations such as ongoing and proposed R&D and waste management. Impacts to workers are given in terms of the number of cancer fatalities resulting from employment activities in the worker population. Impacts to the public from normal releases are given in terms of the probability of the site-wide MEI contracting a fatal cancer from these operations. The number of fatal cancers expected in the general population because of LLNL operations is also described.

Relationship with Site Operations

This section summarizes the relationship between projects described in Section 3.3 for the Proposed Action and radiological health impacts from normal site operations. The Proposed Action dose would increase as new and increased operations come online. The maximum doses and health effects over this timeframe are presented here. The number of cancer fatalities to the workers and the public from exposure to these operations is used to quantify the impacts.

Impact Analysis

Workers

The dose to involved workers, such as those directly exposed to radiation in the performance of their jobs, would be approximately 93 person-rem per year. This dose includes approximately 19 person-rem per year from the NIF. Most of the remainder of this dose would be from operations in Building 332. Workers would be exposed to an increased risk of cancer as a result of occupational exposure to radiation over an extended period (calculated value of 0.055 fatalities per year of operation). Note that radiation exposure in all radiologically controlled areas are kept ALARA through facility and equipment design and administrative controls.

The dose to noninvolved workers, those exposed to normal site radiological emissions not directly related to performance of their jobs, would be approximately 0.14 person-rem per year (see Section 5.3.8.2). Ninety-seven percent of this dose is from Livermore Site operations. Approximately 8.4×10^{-5} LCFs per year of operation are expected among noninvolved workers.

General Public

The Proposed Action health impacts to the general public result from the radiation dose from atmospheric emissions, described in Section 5.3.8.2, and skyshine from neutrons produced during the NIF yield operations and scattering off of the atmosphere (skyshine). The latter would be unchanged from the No Action Alternative. The Proposed Action dose to the Livermore Site site-wide MEI would be 0.33 millirem per year (0.13 from air emissions and 0.2 from skyshine). This dose is less than 0.4 percent of the DOE standard of 100 millirems per year (DOE O 5400.5). The probability of a fatal cancer to this site-wide MEI would be 2.0×10^{-7} per year of exposure.

The Proposed Action site-wide MEI dose from Site 300 operations would be 0.055 millirem per year, less than 0.6 percent of the NESHAP standard. This dose is unchanged from the No Action Alternative. The probability of a cancer fatality to this hypothetical individual would be 3.3×10^{-8} per year of operation.

The population dose from all LLNL operations would be 11.6 person-rem per year. Skyshine effects are limited to locations in close proximity to the Livermore Site boundary next to the NIF and are not included in the population dose. Approximately 0.007 fatalities to the public would result annually from exposure to LLNL operations.

Cumulative Impacts

There is a possibility that an involved worker would contract a fatal cancer sometime during that worker's lifetime as a result of occupational exposure under the Proposed Action (calculated value of 0.075 fatalities per year of operation).

No adverse impacts to the general population would occur under the Proposed Action. Other than background radiation sources, there are no other known contributors to concentrations of radionuclides near the Livermore Site or Site 300. Therefore, there are no additional cumulative radiological impacts.

5.3.15 Site Contamination

This section analyzes impacts of contaminated soils and sediments, surface water, and groundwater under the Proposed Action. For the purpose of this LLNL SW/SPEIS, soils and sediments discussed below include surficial soils, both unconsolidated and consolidated sediments, and unsaturated bedrock. Hydrologic impacts not related to surface or groundwater quality are presented in Section 5.3.9.

5.3.15.1 Relationship with Site Operations

The Proposed Action, as described in Section 3.3, includes continued operations of investigation, cleanup, long-term stewardship, other activities (including treatment system modifications and reporting), plus actions identified for the No Action Alternative. A general increase in activity levels across LLNL is projected; accordingly, an increase in hazardous material management and waste management and an associated spill or release could occur. LLNL would conduct immediate cleanup actions and periodic site surveys to ensure environmental impacts would be minimized.

5.3.15.2 Impact Analysis

The Proposed Action would result in minimal deposition of contaminants to soil from continued operations and continued removal of known contaminants under the cleanup effort would occur. No adverse impacts to future designated land use would be expected. No adverse effect on groundwater would be expected. Continued improvement of water quality and source reduction would occur.

5.3.15.3 Cumulative Impacts

The ROI for site contamination involves LLNL and its remedial sites as presented in Chapter 4 of this LLNL SW/SPEIS. The ROI for cumulative impacts is larger than that presented in Chapter 4 and considers the contributions of LLNL (Livermore Site and Site 300) and local projects.

Since the Proposed Action and No Action Alternative begin with the same level of existing contamination, present substantially the same risks for future contamination, and remediation activities would be the same under each, cumulative impacts would be the same as those described in Section 5.2.15.4, combining the potential effects of the No Action Alternative with the effects of other past, present, and reasonably foreseeable activities in the ROI.

Within the ROI, soil contamination and groundwater contamination have occurred from various operations. However, past, present, and planned activities are designed to minimize contamination at LLNL, SNL/CA, and other sites. The cleanup of these sites has been and will be performed to a level that meets State of California approved health risk-based standards, which vary depending on the contaminants of concern, corresponding to the intended future uses of the sites. As existing contamination at LLNL is being cleaned up under the Environmental Restoration Program, no cumulative impacts would be expected.

5.4 IMPACTS FOR THE REDUCED OPERATION ALTERNATIVE

This section discusses the potential environmental consequences of the Reduced Operation Alternative. Chapter 3 and Appendix A contain detailed descriptions of all projects included under the Reduced Operation Alternative. The LLNL operations include the Livermore Site and Site 300.

5.4.1 Land Uses and Applicable Plans

This section describes the impacts to land uses and applicable plans under the Reduced Operation Alternative. Impacts are analyzed for the Livermore Site and Site 300 based on the methodology presented in Section 5.1.

5.4.1.1 Relationship with Site Operations

This section summarizes the relationship between projects described in Section 3.4 for the Reduced Operation Alternative and the land use impact analysis. In general, the effect of projects under the Reduced Operation Alternative on land use are related to the planned construction and D&D of facilities as part of projects that have been funded, but not yet executed. Changes to operations would not alter land use. No land acquisitions would be included under the Reduced Operation Alternative, so land use changes would be confined to onsite areas.

5.4.1.2 Impact Analysis

Livermore Site

Under the Reduced Operation Alternative, new facility construction, upgrades, and D&D activities would occur at the Livermore Site. Many of these projects are already underway. While the types of land uses would not change, some infill and modernization would occur. New facilities that would be located in the undeveloped portions of the Livermore Site are the same as those listed for the No Action Alternative (Table 5.2.1.2–1).

New structures would be for the same uses as existing facilities, R&D, which is the existing land use designation for all Livermore Site facilities. Therefore, they would not represent a change in land uses, nor lead to a conflict with existing and approved future land uses adjacent to the site. Although the Livermore Site is on Federal land and not subject to local zoning ordinances, the Livermore Site R&D activities would be compatible with the MP designation (industrial park) in Alameda County and the I-2/I-3 designations (professional and administrative offices/R&D facilities) in the city of Livermore (LLNL 2001r). No new types of land uses would be introduced in the buffer and perimeter areas. No change in the site's compatibility with existing and approved future land uses would result from the Reduced Operation Alternative. No new impacts are expected.

Secondary effects on land use could occur due to decreased personnel and activity at the site. These effects could include reduced traffic, noise, vehicular exhaust emissions, demands for community services, reduced consumption of natural resources, and reduced waste generation. These effects are addressed in the other parts of Chapter 5 in this LLNL SW/SPEIS.

Site 300

The Reduced Operation Alternative at Site 300 would include upgrades and a D&D project. No land acquisitions would be included. The types of land uses at Site 300 would not change, and the open space character of the site would be retained. No major alteration in the types of land uses would result.

Land uses at Site 300 are compatible with the existing land uses, approved land use designations surrounding the site, and with open space policies regarding open space resources near the site. Because activities under the Reduced Operation Alternative would be a continuation of existing land uses, they would be compatible with existing and approved future land uses surrounding the site. No new impacts are anticipated.

5.4.1.3 Cumulative Impacts

Livermore Site

The cumulative impact study area, with regard to land uses and planning programs for the Livermore Site, is defined as that area of Alameda County generally east of Tassajara Road in the city of Dublin and Santa Rita Road in the city of Pleasanton. This area encompasses the city of Livermore and eastern unincorporated Alameda County. Large undeveloped open space areas exist in the northern, eastern, and southern portions of Alameda County. The majority of the undeveloped areas are used for agricultural purposes, primarily for grazing and viticulture. Agricultural lands in the South Livermore Valley General Plan Amendment area support an active wine industry.

A continuing land use trend in Alameda County has been the encroachment of residential, commercial, and industrial uses upon agricultural and open space areas. Development of planned and proposed residential projects would contribute to the cumulative loss of agricultural land and open space. However, the Reduced Operation Alternative would not directly contribute to the cumulative effect on the loss of agricultural land and open space because the Livermore Site is already committed to R&D land uses and no acquisition of open space or agricultural land is proposed.

Site 300

The cumulative impact study area with regard to land uses and planning programs for Site 300 is defined as that portion of San Joaquin County generally south of I-205 that encompasses the city of Tracy and southwestern unincorporated San Joaquin County. Land uses in the area south of I-580 in unincorporated San Joaquin County include agricultural (primarily grazing), commercial recreation, and explosives testing facilities (including Site 300).

The city of Tracy, the border of which is located approximately 2 miles northeast of Site 300, has a developed core of residential and commercial uses, which becomes less dense along the outer boundaries of the city. Industrial and agricultural land uses surround the developed part of the city. In 1998, the city of Tracy annexed the Tracy Hills area southwest of I-580, the area of Tracy that is now closest to Site 300. The Tracy Hills planning area is 6,175 acres. In an effort to

preserve agricultural land on the valley floor, the city of Tracy Planning Department is encouraging new development in hillside areas, such as Tracy Hills (City of Tracy 1993).

Such residential communities could be compatible with Site 300, depending on the final design and siting of residences. The city of Tracy also has annexed an area of San Joaquin County that is approximately 2 miles from Site 300 and has planned for residential development in this area. The Tracy General Plan provides for a conservation, or open space, area to be established that would be a buffer zone between Site 300 and any potential new development.

5.4.2 Socioeconomic Characteristics and Environmental Justice

This section analyzes the socioeconomic impacts associated with implementation of the Reduced Operation Alternative. The section organizes the impact analysis by employment and housing and population, with effects delineated by geographic area (counties and cities). Environmental justice issues are also discussed.

5.4.2.1 Relationship with Site Operations

This section summarizes the relationship between projects described in Section 3.4 under the Reduced Operation Alternative and the potential socioeconomic impacts. In general, the effect of projects under the Reduced Operation Alternative on socioeconomics would be limited to the reduction in employment opportunities and accompanying reduction in payroll dollars and the need for housing resulting from curtailed operation of these projects as described below. Projected staffing changes are shown in Table 5.4.2.1–1.

TABLE 5.4.2.1–1.—Input Parameters for Socioeconomic Analysis Under the Reduced Operation Alternative

Parameter	Units	Site	No Action Alternative	Reduced Operation Alternative
Employment	Number of personnel	LLNL	10,650 (all site workers)	9,770 (all site workers)
		Livermore Site	8,900 (LLNL employees) 17,500 (LLNL employees and indirect)	8,180 (LLNL employees) 16,100 (LLNL employees and indirect)
		Site 300	250 (LLNL employees) 490 (LLNL employees and indirect)	230 (LLNL employees) 450 (LLNL employees and indirect)
Expenditures	Dollars (2001)	LLNL	146 M (Bay Area)	134 M (Bay Area)
Payroll	Dollars (2002)	LLNL	690 M (LLNL employees) 1,130 M (direct and indirect)	635 M (LLNL employees) 1,040 M (direct and indirect)

LLNL = Lawrence Livermore National Laboratory; M = million.

5.4.2.2 *Impact Analysis*

To develop estimates of employment levels, employment projections for the Reduced Operation Alternative were based on staffing decreases associated with reduction of activities at existing facilities. Over the next 10 years, LLNL employment at the Livermore Site is projected to decrease by approximately 700 from the No Action Alternative level to 8,180 employees. Therefore, the Reduced Operation Alternative would eliminate 700 direct employment opportunities in Alameda County, and would reduce the growth rate of population and subsequent housing demand. Combined direct and indirect employment loss would be approximately 1,400 within the four-county ROI.

Over the next 10 years, Site 300 employment would decrease by 20 employees from the No Action Alternative level. Combined direct and indirect employment loss would be approximately 40 within the four-county ROI.

Employment and Expenditures

Region

Assuming a 740 combined employee decrease at Livermore Site and Site 300, the payroll under the Reduced Operation Alternative would be \$55 million less than under the No Action Alternative in 2002 dollars. This would result in fewer dollars within the local economy for workers to purchase goods and services. The combined direct and indirect effects of decreased employment would result in an employment decrease of approximately 1,400 within the region. Likewise, the direct and indirect effect of payroll loss would result in a \$90 million decrease from the No Action Alternative in the regional economy.

In addition, the Reduced Operation Alternative would result in reduced expenditures by LLNL. Fewer goods and services would be required to support the activities, facilities, and workers under the Reduced Operation Alternative.

The reduced payroll and other reductions in spending by LLNL would slow the rate of growth in personal income and employment opportunities within the ROI. However, the slower growth in expected personal income and employment under the Reduced Operation Alternative would have a very small economic impact on the region.

Alameda County

Total employment in Alameda County was estimated at 751,680 in the year 2000 (Association of Bay Area Governments 2001). The Reduced Operation Alternative would reduce employment at the Livermore Site by approximately 700 from the No Action Alternative employment level. Employment projections for the county estimate that opportunities would increase 14.1 percent to 857,450 by the year 2010 (Association of Bay Area Governments 2001). The reduction in jobs caused by the Reduced Operation Alternative at LLNL would represent 0.8 percent of the projected increase in employment within the county. This minimal decrease in LLNL employment, a 0.1 percent decrease from the year 2000 employment level, would have a minimal impact to the Alameda County economy.

San Joaquin County

Total nonfarm employment in San Joaquin County was estimated at 191,700 in the year 2001 (EDD 2003). The Reduced Operation Alternative would result in a 20 employee staff reduction at Site 300. Employment projections for the county estimate that employment opportunities will increase 22.3 percent to 234,430 by the year 2010 (SJCOG 2000). The jobs lost under the Reduced Operation Alternative at Site 300 would represent 0.05 percent of the projected increase in employment within the county. This minimal decrease in employment, a 0.01 percent decrease from the 2001 employment level, would have a negligible impact to the San Joaquin County economy.

Population and Housing

For this analysis, to determine the maximum potential impact, it was assumed that any positions eliminated under the Reduced Operation Alternative would result in a family leaving the project region, and that each LLNL worker (including LLNL employees, contractors, and Federal employees) would represent one household. In reality, a significant percentage of workers in positions eliminated would remain in the region, and some households have more than one LLNL worker. The geographic distribution of future LLNL workers would be similar to the current distribution (Table 5.4.2.2–1).

Alameda County

Based on the current geographic distribution of LLNL worker residences (Table 5.4.2.2–1), the Reduced Operation Alternative would result in a net migration of 500 more workers out of Alameda County over 10 years as compared with the No Action Alternative. Assuming 2.74 persons per household for the county (Census 2003), the population associated with the workforce migrating out of the county would be 1,370 persons. This would represent 0.1 percent of the 2000 population within the county. Population projections for the county estimate a 16.8 percent increase from 2001 to 2010 (Association of Bay Area Governments 2001, Census 2003).

Assuming one worker per household, the reduction in housing demand caused by the reduced workforce would be 500 dwelling units less than the No Action Alternative over 10 years, lowering the total number of housing units occupied by LLNL workers to approximately 5,550 within Alameda County. In 2002, the county had 546,735 housing units. The vacancy rate in the county was 3.0 percent, an estimated 16,620 available units (DOF 2002). Reduction in housing demand associated with project personnel leaving Alameda County would represent 3.0 percent of the 2001 housing supply within the county. The slower growth in population increase associated with the Reduced Operation Alternative would have minimal impact on population and housing demand within the county.

City of Livermore

The greatest percentage of LLNL workers leaving the region (333 more than the No Action Alternative or 37 percent of workers expected to leave the ROI) would move from the city of Livermore based on the current pattern of employee residence location. Using the year 2000 person per household figure of 2.81 for the city (Census 2002b), and assuming one worker per household, the population associated with the workforce migrating out of the city would be 936 persons as compared with the No Action Alternative. This would represent 1.3 percent of the city's 2000 population. The projection of population growth for the city is 23 percent from the year 2000 to 2010 (Association of Bay Area Governments 2001). Given the demand for housing within the city of Livermore (development and additional demand for housing limited by the Housing Implementation Plan), the reduced pressure for available housing would have minimal impact to the community or housing market.

TABLE 5.4.2.2–1.—Anticipated Geographic Loss of Lawrence Livermore National Laboratory Worker Residences Under the Reduced Operation Alternative

City	Percent of LLNL Workers ^{a,b}	Decrease in Number of Workers from No Action Alternative ^c
Alameda County		
Livermore	37.0	333
Pleasanton	6.2	56
Castro Valley	4.0	36
Dublin	2.1	19
Oakland	2.1	19
Other Alameda County	4.1	37
Total	55.5	500
San Joaquin County		
Tracy	8.2	74
Manteca	4.8	43
Stockton	2.6	24
Other San Joaquin County	2.9	26
Total	18.5	167
Contra Costa County		
Brentwood	2.7	24
San Ramon	2.7	24
Other Contra Costa County	7.4	66
Total	12.8	114
Stanislaus County		
Modesto	3.2	29
Other Stanislaus County	2.9	26
Total	6.1	55
Counties Outside the ROI		
Total	7.2	65

Source: LLNL 2003ak.

^a Distribution as of September 30, 2002.

^b May not total 100 because figures are rounded off.

^c Calculated based on 900-employee decrease. May not total 900 because of rounding.

ROI = Region of Influence.

City of Pleasanton

Based on the anticipated geographic distribution of personnel leaving the region, it is estimated that 56 LLNL workers would leave the city of Pleasanton over 10 years as compared with the No Action Alternative. Based on the person per household figure of 2.73 in the city for the year 2000 (Census 2002b), the decrease in city population associated with the Reduced Operation Alternative would be 153 persons. This would represent 0.2 percent of the population for the year 2000. Given the high demand for housing within the city of Pleasanton, the out-migration of workers would have a very small impact on the expected demand for housing within the city.

San Joaquin County

Based on the current geographic distribution of personnel, 167 fewer LLNL workers would live in San Joaquin County than under the No Action Alternative (Table 5.4.2.2–1). Based on the person per household figure of 3.17 for the year 2001 in the county (Census 2003), the San Joaquin County decreased population associated with these employees would be 529 persons. This would represent a reduction of 0.1 percent of the total population within the county for the year 2000. The slightly slower growth in population associated with the Reduced Operation Alternative would have only a very small impact to population growth within the county.

Projected housing demand associated with the loss of workers (assuming one worker per household) in the county would total 167 units less than under the No Action Alternative over 10 years, lowering the total number of housing units occupied by LLNL workers to approximately 1,850 within San Joaquin County. The 2002 housing supply within the county was 197,279 units, with a vacancy rate of 3.9 percent (DOF 2002). The total number of vacant units was 7,767. County projections estimate a 26 percent increase in the number of housing units within the county by the year 2010 (SJCOG 2000). The Reduced Operation Alternative would be expected to have a very small impact on the demand for housing within the county.

City of Tracy

Based on the anticipated geographic distribution of personnel leaving the region, 74 fewer workers would be located in the city of Tracy over 10 years than under the No Action Alternative (Table 5.4.2.2–1). Based on the person per household figure of 3.23 for the city in the year 2000 (Census 2002a), the difference in city population associated with the Reduced Operation Alternative would be 239 fewer persons than under the No Action Alternative. This represents 0.4 percent of the population in the year 2000. The Reduced Operation Alternative would be expected to result in a very small impact on the demand for housing in the city of Tracy.

Environmental Justice

In general, LLNL operations under the Reduced Operation Alternative would have no anticipated disproportionately high and adverse health or environmental impacts on low-income or minority populations. Effects would be qualitatively equivalent to those described for the No Action Alternative in Section 5.2.3.2. A number of quantitative differences exist between the data presented in Section 5.2.3.2 and the Reduced Operation Alternative:

- As indicated earlier in this section, 9,770 workers would be required at the Livermore Site, 880 less than under the No Action Alternative. A total of 230 workers would be required at Site 300, 20 less than under the No Action Alternative.
- As presented in Section 5.4.3, an estimated 4,200 metric tons per year of nonhazardous solid waste would be generated at the Livermore Site for disposal, 400 metric tons per year less than under the No Action Alternative. Site 300 generation would decrease by 17 metric tons per year to 191 metric tons per year.
- As presented in Section 5.4.8, the MEI dose from radiological air emissions would be 0.087 millirem per year, lower than the No Action Alternative estimate of 0.098 millirem per year. At Site 300, the MEI dose would be 0.054 millirem per year, slightly lower than the No Action Alternative dose of 0.055 millirem per year.
- As discussed in Section 5.4.11, the collective radiation dose to the population along the transportation route is calculated at 1.1 person-rem per year with 0.0006 LCFs, lower than the No Action Alternative estimates of 5.0 person-rem per year and 0.003 LCFs.
- As presented in Section 5.4.12, the projected peak electrical demand at LLNL would be 81 megawatts, slightly lower than the 82 megawatts under the No Action Alternative.

None of these changes would result in disproportionately high and adverse impacts on low-income or minority populations under the Reduced Operation Alternative.

5.4.2.3 Cumulative Impacts

Approximately 680 fewer LLNL workers would live in the various communities listed in Table 5.4.2.2–1 under the Reduced Operation Alternative than under the No Action Alternative, in the same proportion that existing workers have selected communities for their residences. In addition, approximately 220 workers and their families would leave other communities in the Bay Area and central San Joaquin Valley. The Reduced Operation Alternative would slow the rate of increase in cumulative demand for housing in the region associated with new employment opportunities. However, because of high housing demands within the city of Livermore and the region, the increase in available housing would not impact the community or housing market.

5.4.3 Community Services

The following section evaluates the effects of the Reduced Operation Alternative on providing fire, police, school, and nonhazardous solid waste facilities and services to surrounding communities.

Personnel statistics for employees at the Livermore Site and Site 300 are combined; thus, some of the projections and analyses in this section discuss impacts of employee reductions at the Livermore Site and Site 300 as a single entity.

5.4.3.1 *Relationship with Site Operations*

This section summarizes the relationship between projects described in Section 3.4 for the Reduced Operation Alternative and the community services impact analysis. In general, the effects of projects under the Reduced Operation Alternative on community services would be related to reduction in employment opportunities and changes in floorspace. Employment changes under the Reduced Operation Alternative are detailed in Section 5.4.2. Under the Reduced Operation Alternative, floorspace would increase slightly as construction would not be offset by equal amounts of D&D. Employment parameters are listed in Table 5.4.3.1–1.

TABLE 5.4.3.1–1.—*Input Parameters for Community Services Analysis Under the Reduced Operation Alternative*

Parameter	Units	Site	No Action Alternative	Reduced Operation Alternative
Employment	Number of personnel	Livermore Site Site 300	10,650 250	9,770 230

5.4.3.2 *Impact Analysis*

Livermore Site

Fire Protection and Emergency Services

Under their automatic aid agreement, the Livermore-Pleasanton Fire Department responds to an average of three calls per year at the Livermore Site. The incremental change in Livermore Site floorspace would result in no change in the number of calls to the Livermore-Pleasanton Fire Department and would be anticipated because of the Reduced Operation Alternative. The Livermore-Pleasanton Fire Department's current average of three calls per year at the Livermore Site does not affect that agency's ability to provide fire protection and mutual and automatic aid service to its constituency. Because the Reduced Operation Alternative would not change the number of calls, there would be minimal impacts on the Livermore-Pleasanton Fire Department.

The Alameda County Fire Patrol did not respond to any LLNL Fire Department calls during the 2000-2002 timeframe. Implementation of the Reduced Operation Alternative would not change the number of calls for assistance. Therefore, the Reduced Operation Alternative would not impact the Alameda County Fire Patrol's ability to provide fire protection within its service area or to carry out its mutual aid responsibilities with other agencies.

Police Protection and Security Services

The Livermore Site provides onsite security services and participates in emergency response agreements with the city of Livermore Police Department and Alameda County Sheriff's Department for additional police protection services at the Livermore Site. The decrease of 880 employees at the Livermore Site under the Reduced Operation Alternative would not affect the need for assistance, as the number of incidents where additional police protection is typically requested (for example, demonstrations near the facility) would not be expected to change.

School Services

It was assumed that personnel associated with workforce reduction under the Reduced Operation Alternative would leave the communities listed in Table 5.4.2.2–1 and other communities throughout the Bay Area and central San Joaquin Valley. Thus, a secondary or indirect effect of the Reduced Operation Alternative would be a decrease in student enrollment in those school districts where LLNL employees would otherwise reside. A small decrease in the projected enrollment (180 fewer students over 10 years in the Livermore Valley Joint Unified School District) would not be expected to affect school services.

Nonhazardous Solid Waste Disposal

The Livermore Site currently generates approximately 11,000 metric tons of nonhazardous solid waste per year, of which 4,700 metric tons are disposed of at the Altamont Landfill; the remainder is diverted for recycling or reuse. Assuming decreases in nonhazardous solid waste would be proportional to the anticipated decreases in site employment, the Reduced Operation Alternative would result in a decrease of approximately 400 metric tons of nonhazardous solid waste per year to be disposed of at the landfill.

The projected lifespan of the Altamont Landfill under current conditions extends to the year 2038 (Hurst 2003). The 400-metric-ton reduction in solid waste generated at LLNL for disposal under the Reduced Operation Alternative would not affect the Altamont Landfill lifespan. The decrease in solid waste under the Reduced Operation Alternative would represent only 0.01 percent of permitted landfill throughput; thus minimal impacts are expected.

Site 300

Fire Protection and Emergency Services

The Site 300 fire station and the city of Tracy Fire Department did not respond to any calls in each other's jurisdictions during the 2000-2002 timeframe under their mutual aid agreement. The number of mutual aid responses would not change for either agency under the Reduced Operation Alternative, which assumes no change in building gross square footage at Site 300. Therefore, no new impacts would be expected to the city of Tracy Fire Department's ability to provide fire protection services or mutual aid services.

Through a mutual aid agreement, the Tracy Rural County Fire Protection District currently responds to an average of one call per year at Site 300. The fire station at Site 300 has never received a request for assistance from the Tracy Rural County Fire Protection District. It is anticipated that the number of responses for each agency would not change under the Reduced Operation Alternative. Therefore, there would be no impact to the Tracy Rural County Fire Protection District's ability to provide fire protection within its service area or to fulfill its mutual aid responsibilities with other agencies.

Site 300 participates in a mutual aid network with the California Department of Forestry. No additional impact is projected on the California Department of Forestry's ability to provide fire protection and mutual aid service.

The Reduced Operation Alternative would not result in a change in the need for fire protection services onsite. There would be no impact to offsite agencies with whom LLNL has mutual aid and response agreements.

Police Protection and Security Services

Site 300 provides onsite security services and participates in an emergency response agreement for additional police and security services with the San Joaquin County Sheriff's Department. There would be no change in the demand for police protection and security services; therefore, there would be no additional impacts to onsite security services or on the San Joaquin County Sheriff's Department's ability to provide services to its constituency.

School Services

The impact analysis for school services is combined for the Livermore Site and Site 300 (see the discussion of school services under the Livermore Site heading above). Only a very small impact is expected.

Nonhazardous Solid Waste Disposal

The most accurate measure of the decrease in nonhazardous solid waste generation would be associated with the decrease in personnel generated by the Reduced Operation Alternative.

Under the No Action Alternative, Site 300 is projected to dispose of approximately 208 metric tons of solid waste per year at the Tracy Material Recovery and Solid Waste Transfer Station. A generation rate of 0.83 metric tons per employee per year can be assumed based on the current amount of solid waste generated and disposed of each year by the existing 240 persons at the site. Therefore, based on a projected decrease of 20 workers over the next 10 years, the Reduced Operation Alternative would result in a maximum decrease of approximately 16.6 metric tons per year of solid waste to be disposed of at the Tracy Material Recovery and Solid Waste Transfer Station, or another landfill if necessary. This would not be a substantial reduction and would have no impact on the Tracy Material Recovery and Solid Waste Transfer Station.

5.4.3.3 *Cumulative Impacts*

Changes in the number of employees associated with activities in the ROI would contribute to changes in the cumulative demand for fire and police services in the jurisdictions where these activities occur. However, fire and security services at LLNL are independent departments that do not rely on offsite community agencies to provide primary responses to fire and police emergency calls. No changes demanding these onsite services or is associated with the Reduced Operation Alternative are anticipated. There would be no new impacts to the cumulative demand for offsite fire and police services.

The Reduced Operation Alternative would not significantly alter the cumulative demand for school services in the region. Existing school facilities cannot accommodate student generation from non-LLNL-related development projected within the Livermore Valley Joint Unified School District's jurisdiction. The Reduced Operation Alternative would eliminate

approximately 180 students from the anticipated increase in student enrollment; however, this would not alter the district's ability to plan for and provide school services within its jurisdiction.

The Reduced Operation Alternative would lessen the cumulative demand for solid waste disposal services. The Livermore Site sends solid waste to the Altamont Landfill. The landfill operator projects the lifespan of this landfill will extend to the year 2038. This closure date would not be affected under the Reduced Operation Alternative.

5.4.4 Prehistoric and Historic Cultural Resources

This section presents an evaluation of impacts to cultural resources resulting from implementation of the Reduced Operation Alternative. The impact analysis is organized by location and type of resource. Steps taken to reduce impacts are also discussed, as are the measures to be implemented to ensure compliance with the NHPA.

5.4.4.1 *Relationship with Site Operations*

This section summarizes the relationship between projects described in Section 3.4 for the Reduced Operation Alternative and the analysis of cultural resources. In general, those projects with the potential to impact these resources include construction of new facilities and infrastructure, in addition to D&D, rehabilitation, and renovation of existing facilities.

5.4.4.2 *Impact Analysis*

Livermore Site

The probability of impacting prehistoric resources at the Livermore Site would be very low because: (1) field and archival research have not identified any prehistoric resources; (2) the geomorphic setting of the site makes it unlikely that any such resources exist; and (3) extensive modern horizontal and vertical development has disturbed much of the site. Although no impacts to prehistoric resources would be expected, unrecorded subsurface prehistoric resources still could be inadvertently discovered during construction or other ground-disturbing activities.

To address the inadvertent discovery of cultural material, LLNL would require its employees and contractors to report any evidence of cultural resources unearthed during ground-disturbing activities at the Livermore Site. Work within the immediate vicinity of the discovery would cease until a qualified archaeologist had the opportunity to assess the discovery. If the discovery were deemed potentially significant, work would be stopped until an appropriate treatment plan was developed according to DOE guidelines. NNSA expects no impacts to these resources.

The Reduced Operation Alternative would have the potential to affect important historic buildings and structures on the Livermore Site through D&D, rehabilitation, or renovation of existing facilities. However, implementing the Programmatic Agreement (Appendix G) would avoid, reduce, or mitigate any impacts from these actions.

Site 300

Impacts to known prehistoric and historic resources at Site 300 would be unlikely to result from the Reduced Operation Alternative. NNSA recognizes the sensitivity of the resources and has established buffer zones to protect them. Implementation of the Programmatic Agreement (Appendix G) and continuation of current management practices would result in protection of these sensitive areas. Although no impacts to known resources are expected, there is still the possibility that unrecorded subsurface prehistoric or historic resources still could be inadvertently discovered during construction or other ground-disturbing activities.

To address the inadvertent discovery of cultural material at Site 300 would be addressed as described above for the Livermore Site. NNSA expects no additional impacts to these resources.

The Reduced Operation Alternative would have the potential to affect important historic buildings and structures on Site 300 through D&D, rehabilitation, and renovation of existing facilities. However, implementing the Programmatic Agreement (Appendix G) with responsible state and Federal agencies would avoid, reduce, or mitigate any impacts from these actions.

5.4.4.3 Cumulative Impacts

The Livermore Valley has undergone tremendous growth and development over the past decade. Because preservation measures such as Section 106 are only initiated when Federal agencies are involved, it is likely that the onset of development has caused the irretrievable loss of cultural resources in the region. Because cultural resources exist at both the Livermore Site and Site 300, future program activities could result in resource loss and add to regional attrition of these resources. Any potential impacts to cultural resources at LLNL would be mitigated through implementation of the Programmatic Agreement (Appendix G), thereby reducing LLNL's contribution to resource attritions.

5.4.5 Aesthetics and Scenic Resources

This section presents an evaluation of impacts to aesthetics and scenic resources resulting from implementation of the Reduced Operation Alternative.

5.4.5.1 Relationship with Site Operations

This section summarizes the relationship between the projects described in Section 3.4 for the Reduced Operation Alternative and the analysis of aesthetics and scenic resources. In general, effects to aesthetics and scenic resources would be limited to the construction of buildings, demolition of existing structures, and infrastructure located in areas visible to public viewing.

5.4.5.2 Impact Analysis**Livermore Site**

Activities under the Reduced Operation Alternative that would change the built environment at the Livermore Site would include improvements to existing buildings and infrastructure, D&D of existing buildings, and construction of new facilities. As with the No Action Alternative,

developments and modifications would largely occur within the developed portion of the site, would be similar in character to surrounding uses, and would be largely screened from public view by the surrounding fences and trees. Like the No Action Alternative, developments and modifications would be largely consistent with the existing character of the site, and the site would remain compatible with local and county scenic resource plans and policies.

Construction of new facilities would be the same as for the No Action Alternative. The changes to the built environment as a result of the Reduced Operation Alternative would have no impact on the visual character of the Livermore Site, views of the site from public viewing areas, or existing view sheds of the surrounding environment.

Site 300

Activities under the Reduced Operation Alternative that would change the built environment at Site 300 would include improvements to existing buildings and infrastructure. Development and modifications would largely occur within the developed portion of the site in the GSA and would be similar in character to surrounding uses. Although many specifics of these developments under the Reduced Operation Alternative are not currently known, based on previous LLNL landscaping and development practices, it is anticipated that development of these projects at Site 300 under this alternative would be largely consistent with the existing character of the site.

The locations, types, and extents of construction and improvement activities at Site 300 would be the same as under the No Action Alternative. The site would remain compatible with local and county scenic resource plans and policies. Consequently, the changes to the built environment because of the Reduced Operation Alternative would have no impacts on the visual character of Site 300, views of the site from public viewing areas, or existing view sheds of the surrounding environment.

5.4.5.3 Cumulative Impacts

There are no planned projects near the Livermore Site and Site 300 that, in combination with LLNL activities, would have an adverse effect on existing view sheds or the surrounding environment. There would be no cumulative impacts to aesthetics and scenic resources in the region under the Reduced Operation Alternative.

5.4.6 Geology and Soils

This section analyzes the impact to geology and soils associated with implementation of the project described in Section 3.4 under the Reduced Operation Alternative. The impact analysis is organized by geologic resources, topography and geomorphology, and geologic hazards.

5.4.6.1 Relationship with Site Operations

Under the Reduced Operation Alternative, the future facilities described under the No Action Alternative would be built. The difference between the alternatives lies exclusively in the level of operation only. The facilities for the Livermore Site are listed in Table 5.2.1.2–1.

Future development in the developed area at the Livermore Site would involve areas where soils have already been disturbed and therefore, would not involve any impacts to soils.

At Site 300, the Wetlands Enhancement Project artificial wetlands would be constructed as described under the No Action Alternative.

5.4.6.2 *Impact Analysis*

Geologic Resources

Livermore Site

No known aggregate, clay, coal, or mineral resources would be adversely affected by the Reduced Operation Alternative. None of the activities proceeding under the Reduced Operation Alternative would take place near or upon known or exploitable mineral resources, unique geologic outcrops, or other unique geologic features. None of the Reduced Operation Alternative activities would affect farming or grazing activities.

The Reduced Operation Alternative would include the same facilities to be built in the undeveloped zone at the Livermore Site as part of the No Action Alternative (Figure 5.2.6.1–1). Table 5.2.1.2–1 presents these facilities along with the estimated amount of land that would be disturbed by their construction. A total of 462,000 square feet would be disturbed because of the construction that would proceed under the Reduced Operation Alternative. No additional impacts are expected.

As discussed in Chapter 4, Section 4.8, of the LLNL SW/SPEIS fossils were discovered in the peripheral parts of the excavation for the NIF. The fossil localities were found 20 to 30 feet below the surface. Under the Reduced Operation Alternative, the potential would exist for the inadvertent excavation of fossils within this depth range during construction. Should any buried fossil materials be encountered, LLNL would evaluate the materials and proceed with recovery in accordance with the requirements of the *Antiquities Act*.

Site 300

No known aggregate, clay, coal, or mineral resources would be adversely affected by the Reduced Operation Alternative. Under the Reduced Operation Alternative, the Site 300 Wetlands Enhancement Project and the connection to the Hetch Hetchy Aqueduct would be built at Site 300 as described under the No Action Alternative. There would be no impacts to any known or exploitable mineral resources, or unique geologic features.

Enhancement of the wetland habitat at Mid Elk Ravine and the area of the seep at the former SHARP Facility would involve disturbing 1.09 acres of soil. The connection to the Hetch Hetchy Aqueduct would involve the disturbance of soils along the line of connection. The amount of disturbance would be dependent on the exact path and the engineering of the connection.

Several vertebrate fossil deposits have been found on Site 300 and near Corral Hollow. The fossil finds are generally widely scattered, and no significant invertebrate or botanical fossil localities have been identified on Site 300 or in the surrounding area (Hansen 1991). No projects

under the Reduced Operation Alternative would involve the disturbance of these areas. Therefore, there would be no impacts to any known fossil deposits. Should any buried fossil materials be encountered during any construction, LLNL would evaluate the materials and proceed with recovery in accordance with the requirements of the *Antiquities Act*.

Topography and Geomorphology

Livermore Site

The Reduced Operation Alternative would not include project work that would affect the topography or geomorphology of the Livermore Site. No construction or excavation projects would be planned that would alter the character of the landscape. Only the best management practices would be employed to minimize erosion resulting from ongoing operations; no additional impacts are expected.

Site 300

The Reduced Operation Alternative would not include project work that would affect the topography or geomorphology of Site 300. No construction or excavation projects would be planned that would alter the character of the landscape. Only the best management practices would be employed to minimize erosion resulting from ongoing operations; no additional impacts are expected.

Geologic Hazards

The geologic hazards associated with the Livermore region are part of the character of that region. The hazards exist regardless of the presence of human activities, buildings, or facilities. Therefore, there is no difference in the geologic hazards among the alternatives. Detailed discussion is presented in Section 4.8 and Appendix H of the LLNL SW/SPEIS and includes the major regional fault zones and local faults.

Potentially strong earthquake ground motion sources at the Livermore Site and Site 300 are discussed in Section 4.8 and Appendix H. Potential impacts expected from an earthquake generating horizontal peak acceleration of 0.73 g are discussed as part of the evaluation of accidents in Section 5.5 and Appendix D.

Livermore Site

Adverse impacts to proposed structures and related infrastructure and surrounding communities could occur from hazardous materials releases and/or structural failure of buildings and facilities following a major seismic event. Design and location requirements for new facilities, including waste management facilities, must take into account distance from active faults, and the ground shaking to be expected within certain probabilities.

Site 300

Buildings 899A and 899B at the pistol range could experience ground deformation during a major earthquake on the Carnegie Fault. However, these two structures contain no hazardous or

radiological materials and have very low occupancies. A greater number of facilities are located near the Elk Ravine Fault; however, that fault has not been considered active.

There is potential for seismically induced landslides at Site 300 due to the presence of landslide deposits and steep slopes. The potential for slope instability is greater on northeast-facing slopes that are underlain by the Cierbo Formation. Buildings 825, M825, 826, M51, 847, 851A, 851B, 854, 855, and 856 are located on old landslides. The potential for ground deformation at these buildings located on landslide deposits is considered moderate to high.

A landslide could result in spills, fire, explosions, or burial of facilities within its path. The hazards and impacts of spills, fire, and explosions, regardless of cause are discussed in Section 5.5 and Appendices A and D. The impacts of burial of materials due to a landslide would be similar to spills and the firing of explosives at these facilities. These facilities have material limits under which they work on batches of materials. The working limits for explosives are close to the amounts detonated at the firing sites. The spread of materials into the environment when the explosives are detonated would be similar to the amount of materials that would be buried in a landslide.

5.4.6.3 *Cumulative Impacts*

SNL/CA projects approximately 100 acres of soil disturbance in connection with their activities and future facilities. A large fraction of this is within areas that are already developed. The soils in the vicinity of LLNL are capable of supporting agriculture. While there is a large amount of undeveloped land in Alameda County, continuing development in the immediate vicinity of LLNL is contributing to the cumulative loss of agricultural land. The projects associated with the Reduced Operation Alternative do not contribute to the overall loss of agricultural land since LLNL has been committed to R&D/industrial use instead of agriculture for decades.

5.4.7 *Biological Resources*

This section analyzes the potential impacts of the Reduced Operation Alternative on biological resources, including vegetation, wildlife, protective and sensitive species, and wetlands.

5.4.7.1 *Relationship with Site Operations*

This section summarizes the relationship between projects described in Section 3.3 for the Reduced Operation Alternative and the ecological impact analysis. In general, the effect of the Reduced Operation Alternative projects on biological resources would occur primarily in areas that have been previously disturbed at the Livermore Site and Site 300 by construction, maintenance, wildfire prevention, and security activities.

5.4.7.2 *Impact Analysis*

Vegetation and Wildlife

Livermore Site

It is anticipated that approximately the same land disturbance activities described for the No Action Alternative would occur under the Reduced Operation Alternative. Up to 462,000 square feet (10.6 acres) of land disturbance may occur under this alternative with remaining vegetation consisting of landscaped areas, fields dominated by early successional plant communities indicative of recent disturbance, annual grasslands in the security zone, and remnant wooded riparian vegetation along Arroyo Seco. The wildlife in the plant communities at the Livermore Site consists of species adapted to living in areas of high human activity or species adapted to living in grassland habitat. Therefore, the impacts of this alternative on vegetation and wildlife at the Livermore Site would be minimal.

Site 300

Site 300 vegetation and wildlife consist of a wide range of plant and animal species. The impacts of the Reduced Operation Alternative on vegetation and wildlife would occur primarily in previously disturbed areas representing less than 5 percent of the total site acreage. Under the Reduced Operation Alternative, no new facility construction would involve soil disturbance in new areas, although a number of routine operations such as road grading and culvert maintenance would occur and include protective measures as discussed in Appendix E, Section E.2.2.

Tritium Levels in Vegetation and Commodities

In 2001, as noted in Section 5.2.7, the No Action Alternative maximum potential dose from ingestion of vegetables, milk, and meat for the Livermore Valley was 0.0069 millirem (LLNL 2002cc). With the exception of vegetation from previously identified sites of contamination, the tritium levels at Site 300 were below the limits of detection and comparable to those exposed in previous years. Assuming a hypothetical average wine consumption and using the medium tritium values from the three sampling areas, the annual doses from Livermore, Europe, and California wines in 2001 would have been 0.13 microrem, 0.11 microrem, and 0.037 microrem, respectively (LLNL 2002cc).

No modeling was conducted to estimate tritium levels under the Reduced Operation Alternative in vegetation and other commodities. However, the tritium levels in vegetation and wine would be proportional to the annual release of tritium. These levels would be anticipated to be the same as those for the No Action Alternative, or lower depending on the level that operations at LLNL are reduced. A detailed discussion of tritium levels is presented for the discussion of the No Action Alternative in Section 5.2.7.3. No impacts are expected.

Protected and Sensitive Species

Livermore Site

Under the Reduced Operation Alternative, LLNL would continue to fulfill its obligation to maintain Arroyo Las Positas (previously modified to handle a 100-year flood event) and onsite tributaries for flood capacity. The objective of the Arroyo Las Positas Maintenance Project is to allow the function and needs of onsite drainage capacity of the arroyo to be met in a timely and consistent manner without overlooking the preservation and habitat conservation requirements pertaining to the federally threatened California red-legged frog (LLNL 1998a, USFWS 1997, USFWS 2002e). For further details of the Arroyo Las Positas Maintenance Project and ongoing consultation with the USFWS for this project, see Appendix E, Section E.2.1, of this LLNL SW/SPEIS.

No California red-legged frogs have been identified in the 1,800 feet of Arroyo Seco within the Livermore Site boundaries from the Vasco Road bridge to the East Avenue culvert (LLNL 2003ab). However, this segment of Arroyo Seco could be used by populations of this frog in the vicinity of the site. A separate Biological Assessment prepared to assess the impacts of the proposed Arroyo Seco Management Plan was submitted to the USFWS in August 2003.

Formerly designated critical habitat for the California red-legged frog at the Livermore Site is shown in Figure 4.9.3–1. Construction of most, but not necessarily all, No Action Alternative structures would occur under the Reduced Operation Alternative. The Reduced Operation Alternative projects at the Livermore Site would not be in proposed designated critical habitat for the California red-legged frog or in areas where this species currently occurs.

In 1997, bullfrogs were noted in the southern sediment basin, a sediment trap south of the Drainage Retention Basin. A bullfrog management program, coordinated with the USFWS, was initiated to minimize the adverse impacts of this invasive species, which is a predator of the California red-legged frog (USFWS 2002e). See Appendix E for further discussion.

Measures to protect the California red-legged frog during the Arroyo Las Positas Maintenance Project activities would continue using the same USFWS-approved protection and conservation measures discussed in Section 5.2.7.3. Impacts are expected to be beneficial.

Site 300

Threatened, endangered, and other sensitive flora and fauna species of concern reside at Site 300. Under the Reduced Operation Alternative, most, but not necessarily all, No Action Alternative projects described in Section 3.2 would be completed.

Affected Species

The Reduced Operation Alternative would affect three species: California red-legged frog, California tiger salamander, and Alameda whipsnake, as well as proposed critical habitat for the California red-legged frog, and rescinded critical habitat for the Alameda whipsnake. The California red-legged frog is a federally listed threatened species. Proposed critical habitat for the California red-legged frog and its breeding and nonbreeding locations at Site 300 are shown in

Figure 4.9.3–3. Proposed termination of surface water releases for an artificial wetland at Building 865 would impact this species since it has been a known breeding location for 6 years. Termination of water to a small, artificially maintained wetland at Building 801 would eliminate a potential breeding site for this frog species, although no California red-legged frogs have been observed at this wetland. Elimination of very small wetlands associated with the cooling towers at Buildings 851 and 827 would eliminate two low-quality habitat locations for the California red-legged frog where frogs have not been observed for the past 6 years. Appendix E, Section E.2.2.6.1, of this LLNL SW/SPEIS provides further details on potential impacts of this project and mitigation measures that would be taken to minimize those impacts. Proposed termination of surface releases at Buildings 865, 851, and 827 has been coordinated with the USFWS and has received approval contingent upon implementation of mitigations measures in a recent Biological Assessment and related Biological Opinion (Jones and Stokes 2001, USFWS 2002b). This proposed termination could start as early as 2004 (LLNL 2003ab). Grading of fire trails disturbs sediment that could directly affect California red-legged frog habitat suitability. However, the use of best management practices could reduce negative effects to this species by minimizing erosion of fire trails into drainages as discussed in Appendix E, Section E.2.2.6.1.

LLNL is proposing to mitigate the 0.62-acre artificial wetland removed by continued operations at Site 300 under the Reduced Operation Alternative by enhancing selected areas and increasing breeding opportunities for the California red-legged frog. A minimum of 1.86 acres of wetland habitat would be enhanced and managed for this species. Two mitigation sites for potential enhancement include the wetlands at the seep at the SHARP Facility and Mid Elk Ravine. This mitigation measure has been previously addressed in a recent Biological Assessment and related Biological Opinion (Jones and Stokes 2001, USFWS 2002b). See Appendix E, Section E.2.2.9, for more information on this mitigation measure.

The second affected species is the California tiger salamander, a federally listed threatened species. See Chapter 4, Figure 4.9.3–4, for wetland locations where this species has been observed at Site 300. Although proposed storm drainage and culvert improvement activities could result in direct mortality of California tiger salamanders, proposed mitigations contained in a recent Biological Assessment and related Biological Opinion would greatly minimize the potential for such impacts (Jones and Stokes 2001, USFWS 2002b). Appendix E, Section E.2.2.6.3, provides further details on mitigation measures taken that would be to minimize potential impacts of the Reduced Operation Alternative on this species. Measures designed to mitigate impacts of the Reduced Operation Alternative on the California red-legged frog would also ameliorate impacts on the California tiger salamander. Minimal impacts are expected.

The third affected species is the Alameda whipsnake, a federally listed threatened species. Figure 4.9.3–5 shows rescinded critical habitat and potential habitat for the Alameda whipsnake at Site 300. Grading of fire trails as well as prescribed burns in grasslands adjacent to Alameda whipsnake habitat in sage scrub and rock outcrops have the potential to affect this species. However, a Biological Assessment and related Biological Opinion address mitigations that would minimize the adverse effects from these proposed activities (Jones and Stokes 2001, USFWS 2002b). Fire trail maintenance and prescribed burns are annual activities that would continue during the 10-year period covered by this LLNL SW/SPEIS. Appendix E, Section E.2.2.6.2, provides further details on measures taken to minimize impacts of the Reduced Operation Alternative on this species.

Unaffected Species

Approximately the same level of impacts from land disturbance and continued operations would occur under the Reduced Operation Alternative as under the No Action Alternative. Therefore, the Reduced Operation Alternative would not impact the following federally listed endangered, threatened, or candidate species (for the reasons discussed in Section 5.2.7.3): the large-flowered fiddleneck, the San Joaquin kit fox, the valley elderberry longhorn beetle and the willow flycatcher. Protection and conservation measures discussed in Section 5.2.7.3 would also be conducted under the Reduced Operation Alternative.

Wetlands

Livermore Site

Under the Reduced Operation Alternative, it is anticipated that most, but not necessarily all, No Action Alternative projects would be completed. Construction of new buildings under the Reduced Operation Alternative would occur in upland areas, so that land clearing would not be anticipated to have direct or indirect impacts on natural wetlands. Wetlands along Arroyo Las Positas could be impacted if discharged treated water from the Environmental Restoration Program is terminated; although such termination is not being considered during the time period covered by the LLNL SW/SPEIS. Future actions involving these wetlands could require consultation with the USACE, such as ongoing efforts to develop a water management plan for an 1,800-foot segment of Arroyo Seco within Livermore Site boundaries from the Vasco Road bridge to the East Avenue culvert (LLNL 2001ap). Additionally, the State of California has a no net loss policy regarding wetlands, including artificial wetlands. No impacts are expected.

Site 300

Under the Reduced Operation Alternative, a No Action Alternative Wetlands Enhancement Project would also be constructed to protect and enhance a minimum of 1.86 acres of wetland habitat in conjunction with the termination of artificial wetlands (totaling 0.62 acres) that have been created by cooling tower runoff near Buildings 801, 827, 851, and 865. A Section 404 permit would be required from the USACE and a Section 401 certification of waiver would need to be obtained from the Regional Water Quality Control Board.

5.4.7.3 Cumulative Impacts

Under the Reduced Operation Alternative, cumulative impacts would be essentially the same as under the No Action Alternative, except that a smaller amount of land disturbance would likely occur at the Livermore Site and Site 300. SNL/CA is managing their section of Arroyo Seco to protect California red-legged frog habitat and create a 30-acre wildlife preserve of the east side of that facility.

5.4.8 Air Quality

5.4.8.1 Nonradiological Air Quality

Relationship with Site Operations

The Reduced Operation Alternative allows for continued operation of most LLNL functions, although some planned activities would go forward at a scaled-back rate (i.e., a reduction in operating levels). Scaling back activities would result in a reduction in workforce levels at both sites and therefore, some reduction in vehicular activity and fuel demand. The general parameters that will be used in the analyses of potential air quality impacts are listed in Table 5.4.8.1–1. Impacts are expected to be minimal.

Impact Analysis

Modifications to Facilities or Operations

The Reduced Operation Alternative is similar to the No Action Alternative in that facility and infrastructure renovation (e.g., replacement of ductwork, roofs, installation of seismic and physical security upgrades, and repairs and modifications to roads) activity levels would remain on par with current levels. LLNL would continue to include standard measures for controlling pollution as part of every design and construction project. With the mitigation measures in place as discussed in Sections 5.1.8 and 5.2.8.1, impacts would be similar to current levels.

This alternative would allow the construction and operation of planned and recently approved facilities as discussed under the No Action Alternative, resulting in a 1 percent increase in developed space. While the increase in facility space would result in some additional fuel use, this would be compensated by the scale back in some operating levels, providing a net reduction in demand.

Decommissioning, Decontamination, and Demolition

The Reduced Operation Alternative would include the planned removal of excess and legacy facilities at the Livermore Site. The total space planned for removal and potential air quality impacts would equal that of the No Action Alternative. Mitigation measures that would be used to reduce air emissions associated with D&D actions are discussed in Section 5.2.8.1.

Support Personnel and Vehicular Activity

Scaling back activities would result in a reduction of approximately 900 workers at LLNL. The reduced workforce would result in a corresponding decrease in vehicular activity and therefore, slight reductions in vehicular emissions.

TABLE 5.4.8.1–1.—Summary of Input Parameters for Air Quality Analysis Under the Reduced Operation Alternative

Parameter	Units	Site	Existing Environment	Reduced Operation Alternative
Daily vehicle traffic	1,000 vehicles	Livermore	22.6	20.8
		Site 300	0.5	No change
Air emission sources and facility status	-	Livermore	The Livermore Site would continue to rank as a mid-sized facility, subject to offset requirements for nonattainment pollutants, and employ good controls on POC and NO _x emission sources, remain a minor source for HAP under NESHAP; not a significant source of toxic air pollutants.	No change
		Site 300	Site 300 would remain a small source per definition of the SJVUAPCD and a minor source for HAPs under NESHAPs, not a significant source of toxic air pollutants.	No change

BAAQMD = Bay Area Air Quality Management District; SJVUAPCD = San Joaquin Valley Unified Air Pollution Control District; HAP = hazardous air pollutant; NO_x = oxides of nitrogen; NESHAP = National Emission Standards for Hazardous Air Pollutants; POC = precursor organic compounds.

Conformity

Livermore Site

Similar to the No Action Alternative, the Reduced Operation Alternative allows several planned projects to proceed, and for purposes of the conformity demonstration, it is assumed that projected maximum activity levels and emission rates under these two alternatives will be similar. They differ only in the case of vehicular emissions, which for this assessment assumes just 10 additional trips per day.

Estimated worst-case annual increased air emissions for the Livermore Site under the Reduced Operation Alternative are presented in Table 5.4.8.1–2. The emissions estimates are well below the applicable conformity thresholds; therefore, the Livermore Site projects proposed under the Reduced Operation Alternative are in conformance with CAA requirements and exempt from further analysis.

TABLE 5.4.8.1–2.—Increased Emissions for the Livermore Site Under the Reduced Operation Alternative (tons per year) for an Assumed Worst-Case Year

Emission Source	NO _x	CO	SO _x	PM ₁₀	VOC
Construction Engines ^a	9.5	1.4	0.99	0.44	0.57
Construction Vehicles ^a	0.089	0.56	0.001	0.003	0.064
Construction Dust ^a	-	-	-	6.5	-
Boiler Space Heating	0.06	0.1	-	0.009	0.43
Research Laboratories	-	-	-	-	0.4
Personal and Transport Vehicles	1.0	5.8	0.04	0.58	0.31
Totals	11	7.9	1.0	7.5	1.8
Conformity Threshold ^b	100	100	-	100 ^c	100
2002 Livermore Site Emissions from Permitted Equipment	24	6.2	1	2.2	5.8

^a Category includes renovations, infrastructure improvements and demolition activities.

^b Conformity thresholds are related to the regional classifications with respect to air quality standards. These are discussed in detail in Section 5.2.8.1.

^c PM₁₀ is unclassified with respect to the NAAQS. The listed conformity threshold is provided for comparative purposes, but does not strictly apply.

Site 300

Site 300 construction, maintenance and demolition activities under the Reduced Operation Alternative would be similar to that of the No Action Alternative. Estimated worst-case annual increased air emissions for Site 300 under this alternative are presented in Table 5.4.8.1–3. The emissions estimates are well below the applicable conformity thresholds; therefore, the Site 300 projects proposed under the Reduced Operation Alternative are in conformance with CAA requirements and exempt from further analysis.

TABLE 5.4.8.1–3.—Increased Emissions for Site 300 Under the Reduced Operation Alternative (tons per year) for an Assumed Worst-Case Year

Emission Source	NO _x	CO	SO _x	PM ₁₀	VOC
Construction Engines ^a	2.5	0.36	0.26	0.11	0.15
Construction Vehicles ^a	0.023	0.14	0.0002	0.0008	0.017
Construction Dust ^a	-	-	-	1.7	-
Personal and Transport Vehicles	0.036	0.20	0.0014	0.020	0.011
Totals	2.5	0.71	0.26	1.8	0.17
Conformity Threshold ^b	10	100 ^c	-	70	10
2002 Site 300 Emissions from Permitted Equipment	0.4	0.37	0.026	0.033	0.084

^a Category includes renovations, infrastructure improvements and demolition activities.

^b Conformity thresholds in the San Joaquin air basin are lower (i.e., more stringent) than those in the Bay Area air basin, owing to the severity of the nonattainment classifications. These classifications are discussed in detail in Section 5.2.8.1.

^c To be conservative, a conformity threshold is provided for CO, which is classified as “Attainment-Unclassified.”

5.4.8.2 Radiological Air Quality

This section analyzes the Reduced Operation Alternative radiological air quality impacts due to normal releases from ongoing site operations (e.g., R&D, waste management). Impacts in terms of dose are related to either the Livermore Site or Site 300.

Relationship with Site Operations

This section summarizes the relationship between projects described in Section 3.4 for the Reduced Operation Alternative and radiological air quality. The dose resulting from exposure to routine air emissions from these projects is used to quantify the impacts. The important incremental impact to the No Action Alternative is due to reductions in NIF operations.

Impact Analysis

Livermore Site

The reduction in radiological air emissions and corresponding dose reductions from the No Action Alternative to the Reduced Operation Alternative would be a result of a one-third decrease in NIF releases other than tritium. Tritium emissions from the Tritium Facility would remain 210 curies per year. The resulting site-wide MEI dose from atmospheric emissions, at the same location as for the No Action Alternative, would be 0.1 millirem per year. This dose would be less than 0.9 percent of the NESHAP limit. Thirty-four percent of this dose would be from NIF emissions.

The corresponding population dose would be 1.8 person-rem per year, 86 percent would be a result of Tritium Facility operations. The NIF would have relatively less effect on the population dose than it would on the site-wide MEI dose because many of the important nuclides released are short-lived and would decay prior to reaching the general population. The dose to the non-involved worker population would be 0.13 person-rem per year.

No adverse health impacts from normal radiological air emissions would be expected under the Reduced Operation Alternative at the Livermore Site (see Section 5.4.14.4).

Site 300

The reduction in impact from the No Action Alternative to the Reduced Operation Alternative would be a result of a decrease of tritium releases during explosives experiments to 15 milligrams (or 145 curies). The site-wide MEI dose, at the same location as under the No Action Alternative, would be 0.055 millirem per year, less than the 0.6 percent of NESHAP limit. The population dose would be 9.8 person-rem per year. The dose to the worker population would be 0.005 person-rem per year.

No adverse health impacts from normal radiological air releases would be expected under the Reduced Operation Alternative at Site 300.

Cumulative Impacts

No adverse impacts on radiological air quality would be expected under the Reduced Operation Alternative at either the Livermore Site or Site 300. Other than background radiation sources, there are no other known contributors to concentrations of radionuclides in air within 50 miles of the Livermore Site or Site 300. Therefore, there would be no cumulative radiological air quality impacts.

5.4.9 Water

5.4.9.1 Relationship with Site Operations

This section summarizes the relationship between projects described in Section 3.4 under the Reduced Operation Alternative and the water impact analysis. The effect of projects under the Reduced Operation Alternative on water resources would be related to decreased water use, impervious surfaces and runoff, and decreased use of potential contaminants as a result of construction and operation of projects.

5.4.9.2 Impact Analysis

Livermore Site

Under the Reduced Operation Alternative, impacts to water resources would be expected to be similar to, but slightly less than, those described under the No Action Alternative. This is because similar, but fewer, activities would occur at the Livermore Site under the Reduced Operation Alternative. Due to reductions in activities at the NIF, the Terascale Simulation Facility, and other facilities, as described in Section 3.4, water consumption under the Reduced Operation Alternative would decrease by 16.8 percent from the level estimated under the No Action Alternative. Similarly, increases in impervious surfaces would be less than expected under the No Action Alternative. The surface water and stormwater monitoring program would not change and no impacts to surface water quality would be expected. Because no facilities would be located in either the 100-year or 500-year floodplain, no impact from flooding would be expected, nor would impacts to floodplains occur.

Impacts to groundwater would be similar to those described in the No Action Alternative. Groundwater remediation at the Livermore Site would continue and, therefore, groundwater quality would continue to improve. No discharges to groundwater would occur and potential impacts to groundwater quality from surface water recharge would be minimal because LLNL would continue to comply with NPDES requirements.

Site 300

Under the Reduced Operation Alternative, impacts to water resources would be expected to be similar to, but slightly less than, those described under the No Action Alternative. This is because similar, but fewer, activities would occur at Site 300 under the Reduced Operation Alternative. Water consumption for Site 300 would remain at 0.35 million gallons per day. Similarly, increases in impervious surfaces would be less than expected under the No Action Alternative. The surface water and stormwater monitoring program would not change and no impacts to surface water quality would be expected. Because no facilities would be located in either the 100-year or 500-year floodplain, no impact from flooding would be expected, nor would impacts to floodplains occur.

Impacts to groundwater would be similar to those described in the No Action Alternative. Groundwater remediation at Site 300 would continue and, therefore, groundwater quality would continue to improve. No discharges to groundwater would occur and potential impacts to groundwater quality from surface water recharge would be minimal because LLNL would continue to comply with NPDES requirements.

5.4.9.3 *Cumulative Impacts*

Livermore Site

Under the Reduced Operation Alternative, cumulative impacts to water use, surface and groundwater contaminants, and impervious surfaces would be expected to be similar to, but slightly less than, those described under the No Action Alternative. A complete discussion of cumulative impacts can be found in Section 5.2.9.4.

Site 300

Under the Reduced Operation Alternative, cumulative impacts to water use, surface and groundwater contaminants, and impervious surfaces would be expected to be similar to, but slightly less than, those described under the No Action Alternative. A complete discussion of cumulative impacts can be found in Section 5.2.9.4.

5.4.10 Noise

This section presents noise impacts resulting from implementation of the Reduced Operation Alternative. The analysis is organized by noise-generating LLNL activities such as construction, modifications to and removal of facilities, traffic noise, and impulse noise.

5.4.10.1 *Relationship with Site Operations*

Activities associated with the Reduced Operation Alternative (Section 3.4) would contribute to noise generations, either directly or indirectly.

The general parameters that were used to characterize community noise levels are listed in Table 5.4.10.1–1.

5.4.10.2 *Impact Analysis*

The Reduced Operation Alternative would allow for continued operation of most LLNL functions, although some planned activities at both the Livermore Site and Site 300 would go forward at a scaled-back rate; i.e., a reduction in the planned number of demonstration projects or planned operating levels. Scaling back activities would also result in a reduction in workforce levels at both sites.

Modifications to Facilities or Operations

The Reduced Operation Alternative is similar to the No Action Alternative in that the projected level for construction activities related to facility and infrastructure renovations would remain on par with current levels, and the effect of these activities would not be noticeable beyond the site boundary, owing to the relatively large spatial area of LLNL sites and perimeter buffer zone common to both the Livermore Site and Site 300. Intervening roadways between the sites and community areas also would reduce the impact of onsite-generated noise. These improvements would not introduce any machinery or equipment that would differ from the current HVAC equipment, cooling towers, motors, pumps, fans, generators, air compressors, and loudspeakers. Noise from this equipment would not be noticeable beyond the site boundary. Impacts are expected to be similar to the No Action Alternative.

Traffic Noise

Scaling back activities would result in a reduction in workforce. Approximately 880 fewer workers would be required at the Livermore Site and 20 fewer at Site 300. The reduced workforce would translate into a corresponding decrease in vehicular activity and a slight, although probably not discernible, decrease in ambient noise.

**TABLE 5.4.10.1–1.—Summary of Input Parameters for Analysis of Community Noise Issues
Under the Reduced Operation Alternative**

Parameter	Units	Site	No Action Alternative	Reduced Operation Alternative
Daily vehicle traffic	1,000 vehicles	Livermore	22.6	21
		Site 300	0.5	No change
Explosives testing ^a	Shot frequency (number per year)	Livermore	Shot frequency would not be limited, but would not change appreciably from current levels. Hundreds of experiments are conducted each year (e.g., 501 shots within the HEAF during FY2002)	Shot frequency would not change appreciably.
		Site 300	Shot frequency would not be limited, but would not change appreciably from current levels. Typical activities include about 200 open air tests per year (including gun firings) and could include about 12 to 25 tests per year in the Contained Firing Facility. Activity on open air firing tables will continue to far exceed that in the Contained Firing Facility.	Shot frequency would not change appreciably, although one of the approximately four to six open air hydroshot experiments would likely be eliminated.
	Maximum weight in kilograms	Livermore	Shot weight would continue to range from gram level up to kilogram level.	No change
		Site 300	Shot weight would continue to range from gram level up to kilogram level. Based on the type of explosive used and constraints imposed by LLNL management to limit the maximum allowable sound pressure level, not to exceed 126 dBA in nearby populated areas.	No change

^a LLNL 2003ar.

dBA = A-weighted decibels; FY = fiscal year; HEAF = High Explosive Application Facility; LLNL = Lawrence Livermore National Laboratory.

Impulse Noise

LLNL would continue explosives research testing under the Reduced Operation Alternative at both the Livermore Site, within the HEAF Building, and at Site 300, within the Contained Firing Facility and on open firing tables. The shot frequency (blasts per year) would be scaled back to some extent, although the intensity would remain unchanged and impacts would be the same as under the No Action Alternative. LLNL would continue to use blast forecasting as a tool to determine if explosive tests would affect the surrounding community and to restrict operations when peak impulse noise levels are predicted to exceed 126 dBA in populated areas. LLNL would also continue to perform meteorological monitoring to provide necessary input data for blast forecasting (LLNL 2001s).

Decommissioning, Decontamination, and Demolition

The Reduced Operation Alternative would include the removal of excess and legacy facilities at the Livermore Site equal to that under the No Action Alternative. With the relatively large spatial area and perimeter buffer zone, noise from demolition activities would not be expected to be discernible in offsite areas.

5.4.10.3 *Cumulative Impacts*

The scale back of activities under the Reduced Operation Alternative would not be expected to contribute to cumulative impacts on community noise levels.

5.4.11 Traffic and Transportation

The estimate of traffic congestion is based on the change in employment under the Reduced Operation Alternative compared to the No Action Alternative. Radiological consequences were calculated using DOE transportation models as described in Section 5.1.11. Appendix J of this LLNL SW/SPEIS presents more detail on the methodology and important inputs for radiological transportation analysis.

5.4.11.1 *Relationship with Site Operations*

Section 3.4 describes the projects under the Reduced Operation Alternative. These projects, when combined with current operations, would result in decreased radiological transportation. The major shipments under the Reduced Operation Alternative would result in approximately 265 shipments of special nuclear material, 55 shipments of LLW and MLLW, 3 tritium shipments, and 7 TRU waste shipments (see Section J.5.4 for more details).

5.4.11.2 *Impact Analysis*

Livermore Site

Under the Reduced Operation Alternative, LLNL employment would decrease slightly from the No Action Alternative of 10,650 to approximately 9,770 workers. Radiological transportation under this alternative would slightly decrease from the No Action Alternative. This small percent decrease would result in a small benefit.

Radiological shipments would include reduced numbers of shipments of LLW (39), TRU (11), and special nuclear material (11). Potential impacts from these shipments are presented in Table 5.4.11.2–1. The number of LCFs under the Reduced Operation Alternative would be much less than one (1×10^{-3}) per year.

TABLE 5.4.11.2–1—Collective Dose to the General Public From Radioactive Shipments Under the Reduced Operation Alternative

Shipment Type	Collective Dose (person-rem per year)			
	Along Route	Sharing Route	At Stops	Total
LLW	8.6×10^{-2}	0.91	0.44	1.4
TRU waste	4.1×10^{-3}	5.0×10^{-2}	2.3×10^{-2}	7.7×10^{-2}
Materials ^a	8.1×10^{-3}	0.11	6.2×10^{-2}	0.18
Total	9.8×10^{-2}	1.1	0.52	1.7
No Action Alternative	0.42	4.7	2.2	7.4

^a Nonwaste radioactive materials, including special nuclear materials, tritium, and other materials used for the LLNL mission. LLW = low-level waste; TRU = transuranic.

Site 300

Under the Reduced Operation Alternative, a reduction in the number of hydroshots and a small potential decrease in the number of workers would result in a small decrease in traffic and parking requirements. This impact is expected to be negligible.

5.4.11.3 Cumulative Impacts

Cumulative transportation impacts under the Reduced Operation Alternative would be less than those from either the No Action Alternative or the Proposed Action for both the Livermore Site and Site 300.

5.4.12 Utilities and Energy

This section discusses the potential impacts of the Reduced Operation Alternative on utilities and energy supplies. Utility and energy usage is discussed separately for the Livermore Site and Site 300. LLNL-leased properties (i.e., Almond Avenue, Graham Court, Patterson Pass, and Arroyo Mocho Pump Station) are considered part of the Livermore Site in assessing utility and energy impacts.

5.4.12.1 Relationship with Site Operations

This section summarizes the relationship between projects described in Section 3.4 for the Reduced Operation Alternative and the utilities and energy analysis. In general, the effect of projects for the Reduced Operation Alternative on utilities and energy analyses are related to water consumption, sewage discharges, electricity consumption, and fuel consumption resulting from reductions in the quantity of surveillance and test activity performed under the Reduced Operation Alternative.

5.4.12.2 *Impact Analysis*

Water Consumption

Livermore Site

The existing capacity of the Livermore Site domestic water system is approximately 2.88 million gallons per day. Under the No Action Alternative, water use at the Livermore Site would be approximately 276 million gallons per year (see Section 5.2.12.3).

Due to reductions in activities at the NIF, the Terascale Simulation Facility, and other facilities, as described in Section 3.4, water consumption under the Reduced Operation Alternative would decrease to approximately 230 million gallons per year, a 17 percent reduction from the level estimated under the No Action Alternative. Because the Livermore Site domestic water system has excess capacity and water use would decrease under the Reduced Operation Alternative, no new impacts are expected.

Site 300

Water consumption at Site 300 is expected to be 67,900 gallons per day under the No Action Alternative. Consumption under the Reduced Operation Alternative would remain at this level. No new impacts are expected.

Sewer Discharges

Livermore Site

Under the No Action Alternative, the Livermore Site would discharge approximately 224,000 gallons per day to the sanitary sewer system (see Section 5.1.12.2). Under the Reduced Operation Alternative, LLNL would scale back operations at the NIF and the Terascale Simulation Facility by 33 percent and 40 percent, respectively. However, both facilities would maintain full operations and facility support staff. Therefore, sewer discharges under the Reduced Operation Alternative would remain at the level estimated under the No Action Alternative. No new impacts are expected.

Site 300

Site 300 will discharge approximately 2,100 gallons of sewage per day under the No Action Alternative. Discharges under the Reduced Operation Alternative would remain at these levels. No offsite sewage treatment is conducted for Site 300 wastes and no new impacts are expected.

Electricity Consumption

Livermore Site

The projected peak electrical demand under the Reduced Operation Alternative would be 81 megawatts. Under the No Action Alternative, electricity consumption at the Livermore Site would be approximately 446 million kilowatt-hours per year. Based on reduction activities at the NIF, the Terascale Simulation Facility, and other facilities, as described in Section 3.4, consumption under the Reduced Operation Alternative would decrease by 17 percent from the

level estimated under the No Action Alternative to 371 million kilowatt-hours per year. No new impacts are expected.

Site 300

PG&E supplies electrical power to Site 300. Electricity consumption at Site 300 is approximately 16.3 million kilowatt-hours per year under the No Action Alternative. Consumption under the Reduced Operation Alternative would remain at these levels. No new impacts are expected.

Fuel Consumption

Livermore Site

PG&E supplies natural gas to the Livermore Site. Natural gas consumption for the Livermore Site would average 23,300 therms per day under the No Action Alternative. Consumption under the Reduced Operation Alternative would decrease by 3 percent from the level estimated under the No Action Alternative, or approximately 22,600 therms per day. No new impacts are expected.

Diesel fuel and unleaded gasoline usage would remain constant even under the Reduced Operation Alternative. Consumption of approximately 72,200 gallons diesel fuel per year and 451,800 gallons per year unleaded gasoline is anticipated.

Site 300

Site 300 fuel oil consumption is approximately 16,600 gallons per year under the No Action Alternative. Consumption under the Reduced Operation Alternative would remain at these levels. No new impacts are expected.

5.4.12.3 Cumulative Impacts

Water Consumption

Livermore Site

The Reduced Operation Alternative, together with other developments in the Hetch Hetchy service area, would increase demand for and consumption of water. For example, the population in Alameda County is projected to increase by about 17 percent by the year 2015 (DOF 2001). Residential, commercial, industrial, and other uses in Alameda County are expected to increase proportionally. Other counties in the Hetch Hetchy service area would experience similar growth. This population growth would constitute cumulative impact upon water resources and supply systems in the Hetch Hetchy service area.

Site 300

Current water use at Site 300 is considered to be representative of future consumption rates for the Reduced Operation Alternative. However, development in the vicinity of Site 300 would increase demand for and consumption of water. Population in San Joaquin County is projected to

increase by 30 percent by the year 2015 (DOF 2001). Residential, commercial, industrial, and other uses in San Joaquin County are expected to increase proportionally. This population growth would constitute a cumulative impact on groundwater resources and supply systems. Similarly, population growth in the Hetch Hetchy service area would constitute a cumulative impact on the Hetch Hetchy system.

Sewer Discharges

Livermore Site

The Reduced Operation Alternative, together with other developments in the area, would increase demand for sewage services. Population in Alameda County is projected to increase by about 17 percent by the year 2015 (DOF 2001). Residential, commercial, industrial, and other uses in Alameda County are expected to increase proportionally. This growth in conjunction with sewer discharge from the Livermore Site could constitute a substantial cumulative impact on sewage systems in the area. The LWRP currently receives a total of approximately 6.5 million gallons of effluent per day. While existing LWRP capacity of 8.5 million gallons per day is expected to be sufficient for inflow treatment for the next 10 years, sewage treatment facility improvements are being planned in the region.

Site 300

Because Site 300 sewer discharge and treatment programs are mostly self-contained, no cumulative impact is expected as a result of the Reduced Operation Alternative.

Electricity Consumption

Livermore Site

The Reduced Operation Alternative, together with other developments in the area, would increase electric power demand. Population in Alameda County is projected to increase by about 17 percent by the year 2015 (DOF 2001). Residential, commercial, industrial, and other uses in Alameda County are expected to increase proportionally. This growth in conjunction with the demand for electrical power at the Livermore Site could constitute a substantial cumulative impact on electric power resources in the area. However, electric utilities provide approximately 10,605 million kilowatt-hours per year of electricity to Alameda County (CEC 2001). More than 10,000 megawatts of new electric generation capacity is planned in the PG&E service area, additional generating capacity is planned throughout California and surrounding states (CEC 2000). Expanded electric transmission capability is also planned in the region. If implemented as planned, these additions would provide sufficient capacity to meet Alameda County electrical energy needs for the next 10 years. Therefore, no new impacts are expected.

Site 300

Current electric power consumption at Site 300 is considered to be representative of future consumption rates for the Reduced Operation Alternative. However, the population in San Joaquin County is projected to increase by 30 percent by the year 2015 (DOF 2001). Residential, commercial, industrial, and other electric power uses in San Joaquin County are expected to

increase proportionally. This growth in conjunction with Site 300 electricity use could constitute a substantial cumulative impact on electric power resources in the area. Currently, electric utilities provide approximately 5,106 million kilowatt-hours per year of electricity to San Joaquin County (CEC 2001). However, more than 10,000 megawatts of new electric generation capacity is planned in the PG&E service area, additional generating capacity is planned throughout California and surrounding states (CEC 2000). Expanded electric transmission capability is also planned in the region. These additions would provide sufficient capacity to meet San Joaquin County electrical energy needs for the next 10 years. Therefore, no new impacts are expected.

Fuel Consumption

Livermore Site

The Reduced Operation Alternative, together with other developments in the PG&E service area, would increase the demand for natural gas. Population in Alameda County is projected to increase by about 17 percent by the year 2015 (DOF 2001). Residential, commercial, industrial, and other uses in Alameda County are expected to increase proportionally. This growth could constitute a cumulative impact on natural gas supply systems. However, PG&E's transmission capacity is approximately 130 percent of the demand for natural gas in its service area (CPUC 2001). As required by the California Public Utilities Commission, PG&E uses a 15-year planning horizon for gas transmission and storage capacity and a 10-year planning horizon for local gas distribution systems. Accordingly, PG&E plans to provide sufficient capacity to meet Alameda County needs for the next 10 years. Therefore, no new impacts are expected.

Site 300

Current fuel oil consumption at Site 300 is considered to be representative of future consumption rates for the Reduced Operation Alternative. However, the population in San Joaquin County is projected to increase by 30 percent by the year 2015 (DOF 2001). Fuel oil use in San Joaquin County is expected to increase as the population increases, but at a lower rate. This growth could constitute a cumulative impact on fuel oil supplies in the county. However, overall fuel oil use in California has declined substantially as air quality regulations concerning greenhouse gas emissions become more stringent. Consequently, fuel oil delivery systems within San Joaquin County have large amount of excess capacity. This excess capacity is sufficient to meet San Joaquin County requirements for the next 10 years. Therefore, no new impacts are expected.

5.4.13 Materials and Waste Management

5.4.13.1 *Materials Management*

This section provides an overview of management responsibilities regarding receipt, transfer, and shipment of radioactive, controlled, and hazardous materials under the Reduced Operation Alternative. Appendices A, B, D, M, and N of this LLNL SW/SPEIS include descriptions of programs and buildings associated with use of these materials. The use of these materials historically has resulted in both their planned and inadvertent releases to the environment.

Relationship with Site Operations

New operations are defined as programmatically planned projects with defined implementation schedules that would take place in the future (e.g., the NIF). The Reduced Operation Alternative could include all new operations, D&D projects, and other activities identified in Section 3.4. In general, material usage at LLNL would decrease, consistent with an 8 percent decrease in LLNL operations from the No Action Alternative.

Waste minimization and pollution prevention techniques would further reduce material usage. Average maximum quantities would likely remain constant as material storage space remains constant; however, average quantities would increase to meet demand. Under the Reduced Operation Alternative, material projections used for analysis would not exceed existing material management capacities.

Impact Analysis

The Reduced Operation Alternative would not cause any major changes in the types of materials used onsite. Material usage at LLNL would decrease, consistent with an 8 percent decrease in laboratory operations from the No Action Alternative. Waste minimization and pollution prevention techniques would be expected to increase reductions in material usage. Average maximum quantities would likely remain constant as material storage space remains constant; however, average quantities would be expected to decrease as demand decreases. Under the Reduced Operation Alternative, material projections used for analysis would not exceed existing material management capacities.

Existing Operations

The Reduced Operation Alternative total hazardous material usage would decrease for existing facilities. Under the Reduced Operation Alternative, average quantities would decrease by an estimated 8 percent (Table 5.4.13.1–1) below the No Action Alternative. Annually, approximately 158,000 to 177,000 chemical containers, ranging from 210-liter (55-gallon) drums to gram-quantity vials would be used or stored at LLNL.

For the Livermore Site, approximately 64,000 gallons of liquids would be managed annually with an estimated storage capacity of 227,000 gallons under the Reduced Operation Alternative. Approximately 1.3 million pounds of solids would be handled with a storage capacity of 2.4 million pounds. Solid material storage would not be expected to fluctuate because metals (e.g., lead used for shielding) are less likely to be consumed and more likely to be reused and reclaimed. Regardless, there would be sufficient capacity to accommodate anticipated operations. Approximately 1.1 million cubic feet of mostly industrial gases (argon, helium, hydrogen, oxygen, nitrogen) would be used annually with a storage capacity of 71.6 million cubic feet. Projections for specific hazardous chemicals for existing Livermore Site operations and Site 300 operations are presented in Table 5.4.13.1–1 and Table 5.4.13.1–2, respectively. Additional detail is provided in Appendix B.

New Operations

The Reduced Operation Alternative would include new operations under the No Action Alternative that would offset decreases in annual hazardous material usage rates over the next 10 years. The majority of the offset would be due to the full implementation of NIF and BSL-3 operations. New operations would account for approximately 70,000 gallons of liquids and solids and approximately 20,000 standard cubic feet of industrial gases. Materials expected to support other projects, including the new projects, are described in Tables 5.2.13.1–3 and 5.3.13.1–3. For new facilities, no impacts would be expected because each of the new facilities would be designed to handle expected quantities.

Under the Reduced Operation Alternative, seven facility initiatives would be undertaken, all of which would reduce operations. Site material usage would be expected to decrease slightly because of these facility initiatives. See Appendix B for more information.

Cumulative Impacts

The ROI for materials management involves LLNL and its facilities as presented in Chapter 4 of this LLNL SW/SPEIS.

The ROI for cumulative impacts is larger than that presented in Chapter 4 and considers the contributions of LLNL (Livermore Site and Site 300), SNL/CA, other NNSA activities, local projects and activities, and the State of California. NNSA assessed cumulative impacts by combining the potential effects of the Proposed Action with the effects of other past, present, and reasonably foreseeable activities in the ROI. The Proposed Action was chosen to assess and present a bounding scenario of potential cumulative effects. This approach allowed a conservative analysis or a maximum estimation of cumulative impacts, further discussed in Section 5.3.13.1.

TABLE 5.4.13.1–1.—Types of Hazardous Chemicals in Use at the Livermore Site Under the Reduced Operation Alternative

Chemical	Chemical Abstract Number	No Action Average Maximum/Average Quantity	Reduced Operation Maximum/Average Quantity
Paints/Solvents			
Paint (variety)	NA	700,000/330,000 lb	700,000/305,000 lb
Thinner, lacquer	NA	3,000/515 gal	3,000/475 gal
Methylene chloride	75-09-2	2,000/58 gal	2,000/53 gal
Methyl alcohol	67-56-1	1,800/515 gal	1,800/475 gal
Acetone	67-64-1	1,200/760 gal	1,200/700 gal
Metals			
Lead bricks or ingots	NA	1,000,000 lb	1,000,000 lb
Tantalum	7440-25-7	75,000/20,600 lb	75,000/19,000 lb
Cobalt	7440-48-4	16,500/14,300 lb	16,500/13,300 lb
Aluminum	7429-90-5	5,000/824 lb	5,000/760 lb
Chrome or chromium	7440-47-3	4,700/1,545 lb	4,700/1,425 lb
Acids/Bases/Oxidizers			
Oxygen, compressed	7782-44-7	870,000/78,000 ft ³	870,000/71,000 ft ³
Hydrogen peroxide<52%	7722-84-1	42,000/18,600 gal	42,000/17,100 gal
Ammonium hydroxide	1336-21-6	30,000/1,650 lb	30,000/1,520 lb
Sodium hydroxide	1310-73-2	25,500/14,400 lb	25,500/13,300 lb
Potassium hydroxide	1310-58-3	15,000/410 lb	15,000/380 lb
Sulfuric acid	7664-93-9	11,000/4,640 lb	11,000/4,300 lb
Nitric acid	7697-37-2	7,810/5,150 lb	7,810/4,750 lb
Phosphoric acid	7664-38-2	3,600/1,030 lb	3,600/950 lb
Cyanuric acid	108-80-5	2,500/515 lb	2,500/475 lb
Hydrofluoric acid	7664-39-3	1,500/890 lb	1,500/810 lb
Industrial Gases			
Argon, compressed	7440-37-1	25,000,000/165,000 ft ³	25,000,000/152,000 ft ³
Helium	7440-59-7	5,000,000/310,000 ft ³	5,000,000/285,000 ft ³
Hydrogen, compressed	1333-74-0	1,500,000/52,000 ft ³	1,500,000/47,500 ft ³
Nitrogen, compressed (liquefied, gaseous)	7727-37-9	500,000/133,000 ft ³	500,000/123,500 ft ³
Carbon dioxide	124-38-9	176,000/128,000 ft ³	176,000/118,000 ft ³
Refrigerants			
Freon 113 (1,1,2-Trichloro-1,2,2-trifluoroethane)	76-13-1	170,000/16,500 lb	170,000/15,200 lb
Refrigerant, 123 SUVA, (2,2-Dichloro-1,1,1-trifluoroethane)	306-83-2	35,000/1,550 lb	35,000/1,430 lb
Freon 22 (Chlorodifluoromethane)	75-45-6	9,000/5,150 lb	9,000/4,750 lb
Freon 11 (Trichlorofluoromethane)	75-69-4	10,000/5,150 lb	10,000/4,750 lb
Freon 12 (Dichlorodifluoromethane)	75-71-8	6,300/4,120 lb	6,300/3,800 lb
Freon 14 (Tetrafluoromethane)	75-73-0	2,000/515 ft ³	2,000/475 ft ³

Sources: NNSA 2002c, TiNUS 2003.

Note: Numbers are rounded. Additional chemicals are listed in Appendix B.

ft³ = cubic feet; gal = gallons; lb = pounds; NA = not available.

TABLE 5.4.13.1–2.—Types of Hazardous Chemicals in Use at Site 300 Under the Reduced Operation Alternative

Chemical	Chemical Abstract Number	No Action Average Maximum/Average Quantity	Reduced Operation Maximum/Average Quantity
Paints/Solvents			
Paint (variety)	NA	7,200/1,230 lb	7,200/1,140 lb
Thinner, lacquer	NA	310/125 gal	310/90 gal
Methyl alcohol	67-56-1	90/5 gal	90/5 gal
Acetone	67-64-1	400/35 gal	400/29 gal
Metals			
Lead bricks or ingots	NA	25,000 lb	25,000 lb
Acids/Bases/Oxidizers			
Oxygen, compressed	7782-44-7	16,000/5,150 ft ³	16,000/4,750 ft ³
Sulfuric acid	7664-93-9	845/62 lb	845/57 lb
Cyanuric acid	108-80-5	500/52 lb	500/48 lb
Industrial Gases			
Argon, compressed	7440-37-1	30,000/30,000 ft ³	25,000,000/252,000 ft ³
Helium	7440-59-7	25,000/25,800 ft ³	5,000,000/285,000 ft ³
Hydrogen, compressed	1333-74-0	700/720 ft ³	1,500,000/48,000 ft ³
Nitrogen, compressed (Liquefied, gaseous)	7727-37-9	312,000/288,000 ft ³	500,000/124,000 ft ³
Carbon dioxide	124-38-9	44,000/5,200 ft ³	176,000/118,000 ft ³
Refrigerants			
Freon 113 (1,1,2-trichloro-1,2,2-trifluoroethane)	76-13-1	150/10 gal	150/10 gal
Freon 22 (chlorodifluoromethane)	75-45-6	1,400/910 lb	1,400/827 lb
Freon 12 (dichlorodifluoromethane)	75-71-8	660/230 lb	660/209 lb
Freon 13 (chlorotrifluoromethane)	75-72-9	478/478 ft ³	478/454 ft ³
Freon 14 (tetrafluoromethane)	75-73-0	2,000/515 ft ³	2,000/475 ft ³

Sources: NNSA 2002c, TiNUS 2003.

Note: Numbers are rounded. Additional chemicals are listed in Appendix B.

ft³ = cubic feet; gal = gallons; lb = pounds; NA = not available.

5.4.13.2 Waste Management

This section provides an overview of generation, storage, treatment, and disposal of radioactive, hazardous, mixed, and other wastes, including biohazardous and D&D wastes at LLNL under the Reduced Operation Alternative. Appendices B, M, and N include descriptions of wastes and facilities associated with their use, generation, and management.

Relationship with Site Operations

New operations are defined as programmatically planned projects with defined implementation schedules that will take place in the future, such as the NIF. The Reduced Operation Alternative would include all new operations, D&D projects, and other activities, including permit modifications, identified under the No Action Alternative. In general, waste generation at LLNL would decrease, consistent with an 8 percent decrease in LLNL operations from the No Action Alternative.

Under the Reduced Operation Alternative, waste generation projections used for analysis would not exceed existing waste management capacities.

Impact Analysis

Implementation of the Reduced Operation Alternative would not cause any major changes in the types of waste streams generated onsite. No additional waste storage, treatment, handling capacity, regulatory requirements, or security requirements would be needed. Overall waste generation levels at LLNL would remain essentially consistent with recent generation quantities experienced since 1992. Annually, any increase would be consistent with increases from new operations and normal fluctuations as previously noted. Waste minimization and pollution prevention techniques would be expected to offset a portion of the projected wastes. Between 1993 and 2001, overall (routine and nonroutine) TRU waste, LLW, MLLW, and hazardous waste generation, as reported by DOE, were reduced by 91, 57, 89, and 57 percent, respectively (DOE 2002s). Onsite waste handling capacities are four to five times expected waste volumes. Waste projections used for analysis would not exceed existing offsite waste management disposal capacities. Wastes associated with existing operations, new operations, and special operations are discussed later in this section, including other wastes.

The Reduced Operation Alternative would not eliminate assigned missions or capabilities, but could entail not consolidating, enhancing, or upgrading operations. However, RHWM operations would not be reduced beyond those required to maintain safety, permit requirements, or other agreements, such as the Site Treatment Plan. Several project initiatives would be implemented under the Reduced Operation Alternative, as shown in Table 5.4.13.2–1. The associated waste generation would not change overall generation rates. The Reduced Operation Alternative would allow only partial fulfillment of the RHWM mission by limiting future permit modifications and delaying RCRA closures and would not fully satisfy the purpose and need for agency action.

TABLE 5.4.13.2–1.—Planned Projects Under the Reduced Operation Alternative and Associated Waste Projections

Project Title	Project Description	Expected Waste Streams
Terascale Operations Reduction Simulation Facility	Scale back of operations to reduce use of electricity and cooling load.	Minimal changes to routine waste generation.
Reduce Number of Hydroshots at Site 300	Scale back from the No Action planned number of hydroshots at Site 300 with corresponding decrease in CMS activity.	Minimal changes to routine waste generation.
Reduce Number of EDUs	Reduction in planned number of engineering demonstration.	Minimal changes to routine waste generation.
Reduce Number of Subcritical Assemblies	Reduce number of assemblies for subcritical experiments.	Minimal changes to routine waste generation.
Reduce Pit Surveillance	Reduction in planned number of surveyed pits.	Minimal changes to routine waste generation.
NIF Operations Reduction	Reduce ignition yield from 1,200 MJ/yr to 800 MJ/yr.	Minimal changes to routine waste generation.

Sources: TtNUS 2003.

CMS = chemicals and materials science, EDU = Engineering Demonstration Units; MJ/yr = megajoules per year; NIF = National Ignition Facility.

The Reduced Operation Alternative would include all new operations, D&D projects, and other activities, including permit modifications and RCRA closures, identified under the No Action Alternative, as discussed in Section 5.2.13.2. This alternative would differ from the No Action Alternative in generation of routine waste quantities (Table 5.4.13.2–2) and nonroutine waste quantities (Table 5.4.13.2–2).

Existing Operations

For projection purposes, CY1993-CY2002 routine waste generation data were considered a reasonable range for existing facilities; an average of these years was used. The amount of waste generated from existing operations would reflect proportional decreases in LLNL activity levels. The waste quantities would represent a site-wide aggregate of quantities for each type of waste category. Table 5.4.13.2–2 includes existing operations contributions to the estimated annual (routine) waste generation quantities by waste category. No new impacts are expected.

New Operations

New operations (including project-specific information) wastes are considered to be derived from mission-related work and additive. The waste quantities would represent a site-wide aggregate of quantities for each type of waste category. Table 5.4.13.2–2 includes new operations contributions to the estimated annual (routine) waste generation quantities by waste category. Table 5.4.13.2–2 includes new operations under the Reduced Operation Alternative. Table 5.4.13.2–1 presents qualitative waste information by project. No impacts are expected.

TABLE 5.4.13.2–2.—Routine and Nonroutine Operations Waste Generation Quantities Under the Reduced Operation Alternative and No Action Alternative

Waste Type	Annual Quantities			
	No Action Alternative ^a		Reduced Operation Alternative	
	Routine	Nonroutine	Routine ^b	Nonroutine
LLW	200 m ³ /yr	630 m ³ /yr	180 m ³ /yr	550 m ³ /yr
MLLW	61 m ³ /yr	72 m ³ /yr	42 m ³ /yr	63 m ³ /yr
Total Hazardous ^c	390 metric tons	1,500 metric tons	300 metric tons	1,300 metric tons
TRU	50 m ³ /yr	55 m ³ /yr	45 m ³ /yr	55 m ³ /yr
Mixed TRU	1.7 m ³ /yr	0 m ³ /yr	0.7 m ³ /yr	0 m ³ /yr
Sanitary solid	4,800 metric tons	Included in Routine	4,400 metric tons	Included in Routine
Wastewater	310,000 gal/day	Included in Routine	290,000 gal/day	Included in Routine

Sources: TtNUS 2003.

^aFor routine wastes based on average quantities since 1992 and one standard deviation, expected increase in activity levels, and new operations contributions. No margin was added for nonroutine.

^bBased on average quantities since 1992, expected decrease in activity levels (approximately 8 percent), and new operations (No Action only) contributions.

^cTotal Hazardous includes RCRA hazardous, State-Regulated, and TSCA.

gal/day = gallons per day; LLW = low-level waste; MLLW = mixed low-level waste; m³/yr = cubic meters per year; TRU = transuranic.

Special (Nonroutine) Operations

Waste generation levels for special (nonroutine) program waste, such as for unused chemicals or laboratory closeout, are derived separately from 1993 to 2002 nonroutine waste generation. The amount of waste generated would reflect proportional decreases in LLNL activity levels. The waste quantities would represent a site-wide aggregate of quantities for each type of waste category. Table 5.4.13.2–2 presents estimated annual (nonroutine) waste generation quantities by waste category. No impacts are expected.

All Other Wastes

LLNL operations would also involve the five additional waste management activity areas discussed below.

Biohazardous (includes Medical Waste Management Act) Waste

In 2002, several hundred pounds of biohazardous waste were disposed of at an approved offsite facility. Under the Reduced Operation Alternative, biohazardous waste generation would decrease by 8 percent. The existing waste handling capabilities would be adequate to accommodate this waste. No impacts would occur because offsite disposal capacity would continue to be sufficient.

Construction and D&D Waste

No new construction would occur under the Reduced Operation Alternative.

The Reduced Operation Alternative includes the decontamination and demolition of the same excess facilities as the No Action Alternative.

With approximately 255,000 square feet of excess facilities, to bound impacts, this analysis assumed the removal of all excess facilities. This would generate approximately 1,530 metric tons of debris (600 metric tons per 100,000 square feet). It is estimated that only 350 metric tons would be of the LLW, MLLW, and hazardous variety. Approximately two-thirds of the debris total would be diverted, recycled, or reclaimed (LLNL 2002cc). The existing waste treatment facilities would occur because existing waste handling capabilities are already in handling capabilities would be adequate to accommodate this waste. No impacts would occur because offsite disposal capacity would continue to be sufficient.

Environmental Restoration Waste

Site-wide environmental restoration waste generation trends at LLNL would generally remain a function of treatment units, the number of wells, and the number of hours of operation. No impacts to treatment facilities would occur because existing waste handling capabilities are already in place.

Explosive Waste

The Explosives Waste Treatment Facility would handle 2,400 to 2,800 pounds per year. The Explosive Waste Storage Facility would store (gross) 5,200 to 6,200 pounds per year. This would represent an 8 percent decrease from the No Action Alternative. No additional capacity would be required. No impacts are expected.

Wastewater

Wastewater would decrease to approximately 290,000 gallons per day. The current capacity of 1.69 million gallons per day would be adequate to accommodate this waste. No impacts would occur because offsite disposal capacity would continue to be sufficient.

Permit Modifications, RCRA Closures, Permit Renewal, and Other Planned Activities

The Reduced Operation Alternative would include all permit modifications and a permit renewal identified in the No Action Alternative, as discussed in Section 5.2.13.2. This alternative would differ from the No Action Alternative as follows:

- Submit 50 Class 1 permit modification request (may include more than one item per submittal) over the next 10 years (see Appendix B for details).
- Submit no Class 2 or Class 3 permit modifications over the next 10 years.

These Class 1 permit modifications would enhance existing operations and would likely result in beneficial environmental impacts through improved efficiency. The Reduced Operation Alternative would allow only partial fulfillment of the RHW mission by limiting future permit modifications and would not fully satisfy the purpose and need for agency action.

Cumulative Impacts

The ROI for waste management involves LLNL and its facilities as presented in Chapter 4 of this LLNL SW/SPEIS. The ROI for cumulative impacts is larger than that presented in Chapter 4 and considers the contributions of LLNL (Livermore Site and Site 300), SNL/CA, other NNSA activities, local projects and activities, and the State of California. NNSA assessed cumulative impacts by combining the potential effects of the Proposed Action with the effects of other past, present, and reasonably foreseeable activities in the ROI. The Proposed Action was chosen to assess and present a bounding scenario of potential cumulative effects. This approach allowed a conservative analysis or a maximum estimation of cumulative impacts, as discussed in Section 5.3.13.2.

5.4.14 Human Health and Safety

5.4.14.1 Nonradiological Health Impacts

Operations at LLNL would involve a wide range of activities with the potential for exposures of involved and noninvolved workers and the public hazardous materials or conditions. These hazards would include radioactive material, ionizing and non-ionizing radiation, chemicals,

biological agents, and industrial hazards. Hazardous chemicals to which involved and noninvolved workers could potentially be exposed, under the Reduced Operation Alternative at the Livermore Site and Site 300, are listed in Table 5.4.13.1–1 and Table 5.4.13.1–2.

Relationship with Site Operations

Section 3.4 describes projects under the Reduced Operation Alternative. These projects, when combined with current operations, would result in a decrease in chemical inventories. Construction or demolition activities associated with this alternative would reduce overall site hazards by removing chemical and physical hazards from the workplace. These activities would represent a decrease in potential injuries associated with industrial safety hazards.

Impact Analysis

Under the Reduced Operation Alternative, six facility initiatives would be undertaken, all of which would reduce operations. Site material usage would decrease slightly because of these initiatives. Under the Reduced Operation Alternative, some construction, renovation, or modification of facilities would occur. Although no specific D&D projects were identified under the Reduced Operation Alternative, the potential for completing a D&D project would exist. Under the Reduced Operation Alternative, decreases in average chemical inventories would be expected. The level of exposure to occupational, toxic, or physical hazards encountered by site personnel would be expected to decrease slightly. Impacts are expected to be decreased under the Reduced Operation Alternative.

During the course of routine operations, the potential would exist for some personnel to be exposed to radiological, chemical, biological, and physical hazards. Implementation of the LLNL ISMS would minimize the risk of personnel exposures through characterization and control measures during the planning stages of work activities.

Overall, site usage of toxic substances and physical hazards would decrease under the Reduced Operation Alternative. The reduced use of chemicals is also projected under the Reduced Operation Alternative. This should result in a reduction in the potential for worker exposures. Continued application of site ES&H and ISMS principles would result in minimal impacts to workers and the public. Thus, the impacts of this alternative would not be considered adverse.

Employees at Site 300 perform work in accordance with established site-wide programs as well as Site 300-specific programs. Site-specific integration work sheets, facility safety plans, and standard operating procedures are prepared to supplement activities not covered by site safety plans or the LLNL ES&H Manual (LLNL 2000i). The projects under the Reduced Operation Alternative would result in a decrease in usage of hazardous chemicals.

The proposed decrease in construction, demolition, and renovation activities should represent a moderate impact on the reduction of site injury and illness rates. Additionally, scaling back operations at seven facilities would result in reducing site staff. Injury and illness case rates applied to a reduced staff should lead to an overall reduction in site recordable incidents making these impacts beneficial. Using the 2002 injury and illness data from the year 2002 as bounding, due to the downward trend, the following results would be expected for the lowest site population year under the Reduced Operation Alternative:

- 219 recordable cases
- 66 lost or restricted workday cases
- No fatalities would be expected

Facility upgrades and continued implementation of the site ES&H program components would significantly reduce the risk of personnel exposures. Workplace and personnel monitoring data indicate the effectiveness of the current program (LLNL 2002bk).

The proposed decrease in construction, demolition, and renovation activities should lead to a moderate reduction in site injury and illness rates and would have a beneficial impact.

Cumulative Impacts

The occupational health and safety of workers at LLNL is site-specific and would not be affected by other activities occurring within the area. Cumulative effects for workers would be the same as those presented in the Reduced Operation Alternative impact analysis above.

5.4.14.2 Radiological Health Impacts

This section analyzes the radiological health impacts from the Reduced Operation Alternative. Impacts to workers are given in terms of number of cancer fatalities resulting from employment activities in the worker population. Impacts to the public from normal releases are given in terms of the probability of the site-wide MEI contracting a fatal cancer from these operations. The number of fatal cancers expected in the general population because of LLNL operations is also described.

Relationship with Site Operations

This section summarizes the relationship between projects described in Section 3.4 for the Reduced Operation Alternative and radiological health impacts from normal site operations. The number of cancer fatalities to the workers and general public from exposure to these operations is used to quantify the impacts.

Impact Analysis

Worker

The dose to involved workers, those directly exposed to radiation in the performance of their jobs, would be 38 person-rem per year versus 89 person-rem per year in the No Action Alternative. This dose includes approximately 10 person-rem per year from the NIF. Most of the remainder of this dose would be from operations in Building 332. Workers would be exposed to an increased risk of cancer as a result of occupational exposure to radiation over an extended period (calculated value of 0.023 fatalities per year of operation). Note that radiation exposure in all radiologically controlled areas would be kept ALARA through facility and equipment design and administrative controls.

The dose to noninvolved workers, those exposed to normal site radiological emissions not directly related to performance of their jobs, would be approximately 0.13 person-rem per year, as discussed in Section 5.4.8.2. Over 95 percent of this dose is from Livermore Site operations. Approximately 7.8×10^{-5} fatalities per year of operation are expected to noninvolved workers.

General Public

The Reduced Operation Alternative impacts to the public would be a result of the radiation dose from atmospheric emissions described in Section 5.4.8.2. The dose to the Livermore Site site-wide MEI would be 0.22 millirem per year (0.09 from airborne effluents and 0.13 from skyshine). This dose is 0.2 percent of the DOE standard at 100 millirem per year (DOE O 5400.5). The probability of a fatal cancer to this site-wide MEI would be 1.3×10^{-7} per year of exposure versus 1.8×10^{-7} for the No Action Alternative.

The Reduced Operation Alternative site-wide MEI dose from Site 300 operations would 0.053 millirem per year, less than 0.6 percent of the NESHAP standard. This dose is essentially the same as for the No Action Alternative. The probability of a cancer fatality to this hypothetical individual would be 3.3×10^{-8} per year of exposure.

The population dose from all LLNL operations would be 11.6 person-rem per year. Skyshine effects are limited to locations in close proximity to the Livermore Site boundary next to the NIF and are not included in the population dose. Approximately 0.007 fatalities to the public would result annually from exposure to LLNL operations.

Cumulative Impacts

There is a possibility that an involved worker would contract a fatal cancer at some point during his or her lifetime as a result of occupational exposure under the Reduced Operation Alternative per year of operation (calculated value of 0.023 fatalities per year of operation versus 0.053 fatalities).

No adverse impacts to site workers or the general population would occur under the Reduced Operation Alternative. Other than background radiation sources, there would be no other known contributors to concentrations of radionuclides near the Livermore Site or Site 300. Therefore, there would be no new cumulative radiological impacts.

5.4.15 Site Contamination

The following section analyzes impacts of contaminated soils and sediments, surface water, and groundwater under the Reduced Operation Alternative.

5.4.15.1 Relationship with Site Operations

The Reduced Operation Alternative would include continued operations of investigation, cleanup, long-term stewardship, other activities including treatment system modifications and reporting and new actions identified under the No Action Alternative, as discussed in Section 5.2.13.2.

A general decrease in activity levels across the site is projected. Accordingly, a decrease in hazardous material and waste management and the potential for associated spill or release could occur. LLNL would conduct immediate cleanup actions and periodic site surveys to ensure environmental impacts would be minimized.

5.4.15.2 *Impact Analysis*

The Reduced Operation Alternative would result in minimal deposition of contaminants from continued operations to soil and continued removal of known contaminants under the cleanup effort would occur. No adverse impacts to future designated land use would be expected. No adverse effect on groundwater would be expected. Continued improvement of water quality and source reduction would occur.

5.4.15.3 *Cumulative Impacts*

The ROI for site contamination involves LLNL and its remedial sites as presented in Chapter 4 of this LLNL SW/SPEIS. The ROI for cumulative impacts is larger than that presented in Chapter 4 and considers the contributions of LLNL (Livermore Site and Site 300) and local projects.

Since the Reduced Operation Alternative and No Action Alternative begin with the same level of existing contamination, risks for future contamination and remediation activities would be the same. Cumulative impacts would be the same as those described in Section 5.2.15.4, combining the potential effects of the No Action Alternative with the effects of other past, present, and reasonably foreseeable activities in the ROI.

Within the ROI, soil contamination and groundwater contamination have occurred from various operations. However, past, present, and planned activities are designed to minimize contamination at LLNL, SNL/CA, and other sites. The cleanup of these sites has been and will be performed to a level that meets State of California approved health risk-based standards (which vary depending on the contaminants of concern) corresponding to the intended future uses of the sites. As existing contamination at LLNL is being cleaned up under the Environmental Restoration Program, no cumulative impacts would be expected.

5.5 BOUNDING ACCIDENT SCENARIOS

NEPA requires that an agency evaluate reasonably foreseeable adverse effects on the human environment in an EIS. This LLNL SW/SPEIS informs the decisionmaker and the public about the chances that reasonably foreseeable accidents associated with the No Action Alternative, Proposed Action, and Reduced Operation Alternative could occur, as well as the potential adverse consequences. An accident is considered bounding if no reasonably foreseeable accident can be found with greater consequences. An accident is reasonably foreseeable if the analysis of occurrence is supported by credible scientific evidence, is not based on pure conjecture, and is within the rule of reason (40 CFR §1502.22[b][4], DOE O 5400.5, DOE 1993b, DOE 2002t).

This section presents the potential impacts on workers, both involved and noninvolved, and the public due to potential accidents associated with operation of LLNL. Additional details supporting the information presented here, as well as approach to the analysis, are provided in Appendix D. Offsite transportation accidents are presented in Appendix J.

Many research activities at LLNL require the use of radioactive materials, hazardous chemicals, explosives and biological hazards, all of which have the potential, under certain circumstances, to be involved in an accident. These materials are received at the sites, transferred onsite, and often shipped offsite. Activities using these materials onsite involve specialized facilities with appropriate safety equipment and procedures to reduce the possibility or the severity of accidents.

An accident is a sequence of one or more unplanned events with potential outcomes that endanger the health and safety of workers and the public. An accident can involve a combined release of energy and hazardous materials (radiological or chemical) that might cause prompt or latent health effects. The sequence usually begins with an initiating event, such as human error, equipment failure, or earthquake, followed by a succession of other events that could be dependent or independent of the initial event, which dictate the accident's progression and the extent of materials released. Initiating events are presented in Appendix D of this LLNL SW/SPEIS.

If an accident were to occur involving the release of radioactive, chemical, or biological materials, workers, members of the public, and the environment would be at risk. Workers in the facility where the accident occurs would be particularly vulnerable to the effects of the accident because of their location. The offsite public and noninvolved workers would also be at risk of exposure to the extent that meteorological conditions exist for the atmospheric dispersion of released hazardous materials. Using approved computer models, NNSA predicted the dispersion of released hazardous materials and their effects. However, prediction of latent potential health effects becomes increasingly difficult to quantify for facility workers as the distance between the accident location and the worker decreases. This is because the individual worker exposure cannot be precisely defined with respect to the presence of shielding and other protective features. The facility worker also may be injured or killed by physical effects of the accident itself.

5.5.1 Radiological Accident Scenarios

5.5.1.1 Methodology

Selection Process

The selection process for radiological accident scenarios used a multistep screening process to identify bounding events. For accidents associated with specific LLNL facilities, the screening process began with a review of all LLNL facilities with emphasis on building hazard classification, radionuclide inventories, including type, quantity, and physical form, and storage and use conditions. The selection process described in Appendix D reduced this list to 23 existing facilities and 5 proposed facilities and projects.

For each of these facilities, the next step was to identify the most current documentation describing and quantifying the risks associated with its operation. Current safety documentation was obtained for all of these facilities. From these documents, the next step was to identify potential accident scenarios and source terms (release rates and frequencies) associated with those facilities. Table D.2.4–1 in Appendix D lists the results of this process and serves as the basis for the subsequent consequence analysis described below.

Consequence Analysis

Consequences of accidental radiological releases were determined using the MACCS2 computer code (Chanin and Young 1997). MACCS2 is a DOE/Nuclear Regulatory Commission-sponsored computer code that has been widely used in support of probabilistic risk assessments for the nuclear power industry and in support of safety and NEPA documentation for facilities throughout the DOE complex.

Because of assumptions used in this LLNL SW/SPEIS analysis, not all of the code's capabilities were used. It was conservatively assumed that there would be no evacuation or protection of the surrounding population following an accidental release of radionuclides. This assumption is not expected to significantly affect the calculated doses.

NNSA estimated radiological impacts to four receptors: (1) the MEI at the LLNL boundary, (2) the offsite population within 50 miles of LLNL, (3) a noninvolved worker 100 meters from the accident location, and (4) the population of noninvolved workers.

Ten radial rings and 16 uniform direction sectors were used to calculate the collective dose to the offsite population. The radial rings were every 1 mile to 5 miles, a ring at 10 miles, and a ring every 10 miles for the initial 10 to 50 miles starting at the distribution center. The MEI was assumed to be located along the site boundary. The shortest distance to the boundary from each release location in all 16 directions was identified for the MEI analysis. Similarly, the noninvolved onsite worker location was taken as 100 meters from the release in any direction.

The calculated radiation doses were converted into LCFs using the factor of 6×10^{-4} LCFs per person-rem for both members of the general public and workers (Lawrence 2002).

5.5.1.2 Results

Table 5.5.1.2–1 presents the bounding radiological accident scenario for each of the evaluated facilities. Table D.2.4–1 in Appendix D presents all of the analyzed scenarios for each LLNL facility, which provides the basis for the bounding facility accident scenarios presented in Table 5.5.1.2–1. Detailed descriptions of the accident scenarios are presented in Appendix D.

Onsite transportation differs from the other facilities because accidents can occur at various locations with various consequences. Each of the three accidents considered for onsite transportation is bounding for particular receptors. All three accidents are presented in Tables 5.5.1.2–1 and 5.5.1.2–2.

Tables 5.5.1.2–1 and 5.5.1.2–2 show the building number and name, the scenario description, frequency, and results for the Proposed Action and the No Action Alternative. The values for the Reduced Operation Alternative are the same as for No Action Alternative. The results presented include estimates of radiation dose and corresponding incremental LCFs for both median (Table 5.5.1.2–1) and unfavorable (Table 5.5.1.2–2) meteorological conditions. The term “unfavorable” meteorological conditions means those conditions that result in radiation doses that would be exceeded only 5 percent of the time. Detailed discussion on meteorological conditions is presented in Appendix D, Section D.2.1 of this LLNL SW/SPEIS.

The bounding accident for each receptor is shaded in Table 5.5.1.2–1 and 5.5.1.2–2. The Reduced Operation Alternative scenarios are the same as for the No Action Alternative. Detailed descriptions of all accident scenarios are provided in Appendix D.

For median meteorology, the bounding accident scenarios for each receptor are as follows:

- For the offsite population, the bounding accident for the Proposed Action is an aircraft crash into Building 625. This accident is estimated to result in 2,020 person-rem to this population, which would result in an additional 1.21 LCFs in this population. For the No Action Alternative, the bounding accident is an aircraft crash into Building 696R, which is estimated to result in 1,290 person-rem (0.77 LCFs)
- For the MEI, the bounding accident for the Proposed Action and the No Action Alternative is an aircraft crash into Building 696R. This accident is estimated to result in 0.861 rem to the MEI, which would result in a probability of 5.17×10^{-4} of the development of a fatal cancer.
- For the population of noninvolved workers, the bounding accident for the Proposed Action and the No Action Alternative is an evaluation basis fire in Building 251, which is estimated to result in 826 person-rem (0.5 LCFs).
- For an individual noninvolved worker for the Proposed Action and the No Action Alternative, the bounding accident is an evaluation basis fire in Building 251. This accident is estimated to result in 5.7 rem to the noninvolved worker, which would result in a probability of 3.42×10^{-3} of the development of a fatal cancer.

TABLE 5.5.1.2–1.—Potential Accident Frequency and Consequences (Median Meteorology)^a

Building	Accident	MEI			Offsite Population ^b		Individual Noninvolved Worker		Noninvolved Worker Population	
		Frequency (per year)	Dose (rem)	LCFs ^c	Dose (Person-rem)	LCFs ^d	Dose (rem)	LCFs ^c	Dose (Person-rem)	LCFs ^d
Building 191	Radioactive material dispersion from a spill and fire - No Action	$<10^{-6}$	3.32×10^{-5}	1.99×10^{-8}	4.70×10^{-3}	2.82×10^{-6}	7.23×10^{-5}	4.34×10^{-8}	9.72×10^{-3}	5.83×10^{-6}
	Radioactive material dispersion from a spill and fire - Proposed Action	$<10^{-6}$	Same	Same	Same	Same	Same	Same	Same	Same
Building 194	Design-basis earthquake and fire - No Action	10^{-6} to 10^{-4}	8.66×10^{-4}	5.20×10^{-7}	2.23×10^{-1}	1.34×10^{-4}	3.43×10^{-3}	2.06×10^{-6}	5.83×10^{-1}	3.50×10^{-4}
	Design-basis earthquake and fire-Proposed Action	10^{-6} to 10^{-4}	Same	Same	Same	Same	Same	Same	Same	Same
Building 239	Uncontrolled oxidation of plutonium at elevated temperature - No Action	$<4.5 \times 10^{-7}$	1.73×10^{-2}	1.04×10^{-5}	6.49	3.89×10^{-3}	2.47×10^{-1}	1.48×10^{-4}	2.59×10^1	1.55×10^{-2}
	Uncontrolled oxidation of plutonium at elevated temperature - Proposed Action	$<4.5 \times 10^{-7}$	Same	Same	Same	Same	Same	Same	Same	Same
Building 251	Evaluation basis fire - No Action	10^{-6} to 10^{-4}	6.01×10^{-1}	3.61×10^{-4}	1.88×10^2	1.13×10^{-1}	5.70	3.42×10^{-3}	8.26×10^2	4.96×10^{-1}
	Evaluation basis fire - Proposed Action	10^{-6} to 10^{-4}	Same	Same	Same	Same	Same	Same	Same	Same
Building 331	Plutonium Metal Fire - No Action	10^{-6} to 10^{-4}	5.02×10^{-2}	3.01×10^{-5}	2.39×10^1	1.43×10^{-2}	6.40×10^{-1}	3.84×10^{-4}	8.95×10^1	5.37×10^{-2}
	Aircraft crash with subsequent fire - Proposed Action	1.53×10^{-6}	1.63×10^{-1}	9.78×10^{-5}	1.13×10^2	6.78×10^{-2}	2.11	1.27×10^{-3}	2.73×10^2	1.64×10^{-1}
Building 332	Aircraft Crash - No Action	4.86×10^{-6}	1.48×10^{-1}	8.85×10^{-5}	9.70×10^1	5.82×10^{-2}	1.84	1.10×10^{-3}	3.18×10^2	1.91×10^{-1}
	Room Fire Unfiltered - Proposed Action	3.90×10^{-7}	2.94×10^{-1}	1.76×10^{-4}	1.87×10^2	1.12×10^{-1}	3.29	1.97×10^{-3}	6.20×10^2	3.72×10^{-1}

TABLE 5.5.1.2–1.—Potential Accident Frequency and Consequences (Median Meteorology)^a (continued)

Building	Accident	MEI			Offsite Population ^b		Individual Noninvolved Worker		Noninvolved Worker Population	
		Frequency (per year)	Dose (rem)	LCFs ^c	Dose (Person-rem)	LCFs ^d	Dose (rem)	LCFs ^c	Dose (Person-rem)	LCFs ^d
Building 334	Uncontrolled oxidation of plutonium at elevated temperatures - No Action	$< 1.00 \times 10^{-6}$	1.64×10^{-1}	9.84×10^{-5}	6.80×10^1	4.08×10^{-2}	3.25	1.95×10^{-3}	2.31×10^2	1.39×10^{-1}
	Uncontrolled oxidation of plutonium at elevated temperatures - Proposed Action	$< 1.00 \times 10^{-6}$	Same	Same	Same	Same	Same	Same	Same	Same
Building 581	Earthquake - No Action	2.00×10^{-8}	4.78×10^{-4}	2.87×10^{-7}	1.96×10^{-1}	1.18×10^{-4}	1.43×10^{-3}	8.60×10^{-7}	2.08×10^{-1}	1.25×10^{-4}
	Earthquake during plutonium experiment without yield - Proposed Action	2.00×10^{-9}	1.65×10^{-3}	9.89×10^{-7}	5.46×10^{-1}	3.28×10^{-4}	4.99×10^{-3}	3.00×10^{-6}	7.41×10^{-1}	4.45×10^{-4}
Building 625	Aircraft Crash - No Action	6.10×10^{-7}	2.39×10^{-1}	1.43×10^{-4}	6.62×10^2	3.97×10^{-1}	6.49×10^{-1}	3.89×10^{-4}	3.04×10^1	1.82×10^{-2}
	Aircraft Crash - Proposed Action	6.10×10^{-7}	7.27×10^{-1}	4.36×10^{-4}	2.02×10^3	1.21	1.97	1.18×10^{-3}	9.24×10^1	5.54×10^{-2}
Building 696R	Aircraft Crash - No Action	6.29×10^{-7}	8.61×10^{-1}	5.17×10^{-4}	1.29×10^3	7.71×10^{-1}	1.39	8.33×10^{-4}	8.33×10^1	5.00×10^{-2}
	Aircraft Crash - Proposed Action	6.29×10^{-7}	Same	Same	Same	Same	Same	Same	Same	Same
Site 300 Materials Management Facilities	Depleted uranium release by fire - No Action	10^{-4} to 10^{-2}	3.93×10^{-4}	2.36×10^{-7}	3.81×10^{-1}	2.29×10^{-4}	3.94×10^{-2}	2.36×10^{-5}	9.42×10^{-2}	5.65×10^{-5}
	Depleted uranium release by fire - Proposed Action	10^{-4} to 10^{-2}	Same	Same	Same	Same	Same	Same	Same	Same

TABLE 5.5.1.2–1.—Potential Accident Frequency and Consequences (Median Meteorology)^a (continued)

Building	Accident	MEI			Offsite Population ^b		Individual Noninvolved Worker		Noninvolved Worker Population	
		Frequency (per year)	Dose (rem)	LCFs ^c	Dose (Person-rem)	LCFs ^d	Dose (rem)	LCFs ^c	Dose (Person-rem)	LCFs ^d
Onsite Transportation	Radioactive and Hazardous Waste Management package explosion - No Action	$< 1.00 \times 10^{-6}$	4.13×10^{-1}	2.48×10^{-4}	1.46×10^1	8.76×10^{-3}	8.63×10^{-1}	5.18×10^{-4}	6.88×10^1	4.13×10^{-2}
	Radioactive and Hazardous Waste Management package explosion - Proposed Action	$< 1.00 \times 10^{-6}$	5.50×10^{-1}	3.30×10^{-4}	1.95×10^1	1.17×10^{-2}	1.15	6.90×10^{-4}	9.17×10^1	5.50×10^{-2}
	Radioactive and Hazardous Waste Management Truck Fire - No Action	$< 1.00 \times 10^{-6}$	1.09×10^{-1}	6.54×10^{-5}	1.01×10^2	6.06×10^{-2}	3.50×10^{-1}	2.10×10^{-4}	7.36×10^1	4.42×10^{-2}
	Radioactive and Hazardous Waste Management Truck Fire - Proposed Action	$< 1.00 \times 10^{-6}$	Same	Same	Same	Same	Same	Same	Same	Same
	Materials Management Section package explosion - No Action	$< 1.00 \times 10^{-6}$	1.16×10^{-1}	6.96×10^{-5}	4.01×10^1	2.41×10^{-2}	2.79	1.67×10^{-3}	1.71×10^2	1.03×10^{-1}
	Materials Management Section package explosion - Proposed Action	$< 1.00 \times 10^{-6}$	Same	Same	Same	Same	Same	Same	Same	Same

Source: Original

^a The consequences for the Reduced Operation Alternative would be the same as for the No Action Alternative.^b Based on the population of approximately 6,900,000 persons residing within 50 miles of LLNL.^c Increased likelihood of a latent cancer fatality.^d Increased number of latent cancer fatalities.

LCFs = latent cancer fatalities; MEI = maximally exposed individual.

TABLE 5.5.1.2–2.—Potential Accident Frequency and Consequences (Unfavorable Meteorology)^a

Building	Accident	MEI			Offsite Population ^b		Individual Noninvolved Worker		Noninvolved Worker Population	
		Frequency (per year)	Dose (rem)	LCFs ^c	Dose (Person-rem)	LCFs ^d	Dose (rem)	LCFs ^c	Dose (Person-rem)	LCFs ^d
Building 191	Radioactive material dispersion from a spill and fire - No Action	$<10^{-6}$	4.25×10^{-4}	2.55×10^{-7}	4.20×10^{-2}	2.52×10^{-5}	7.14×10^{-4}	4.28×10^{-7}	6.96×10^{-2}	4.18×10^{-5}
	Radioactive material dispersion from a spill and fire - Proposed Action	$<10^{-6}$	Same	Same	Same	Same	Same	Same	Same	Same
Building 194	Design-basis earthquake and fire - No Action	10^{-6} to 10^{-4}	1.30×10^{-2}	7.80×10^{-6}	1.81	1.09×10^{-3}	3.30×10^{-2}	1.98×10^{-5}	3.47	2.08×10^{-3}
	Design-basis earthquake and fire-Proposed Action	10^{-6} to 10^{-4}	Same	Same	Same	Same	Same	Same	Same	Same
Building 239	Uncontrolled oxidation of plutonium at elevated temperature - No Action	$<4.5 \times 10^{-7}$	3.68×10^{-1}	2.21×10^{-4}	1.02×10^2	6.12×10^{-2}	2.97	1.78×10^{-3}	2.02×10^2	1.21×10^{-1}
	Uncontrolled oxidation of plutonium at elevated temperature - Proposed Action	$<4.5 \times 10^{-7}$	Same	Same	Same	Same	Same	Same	Same	Same
Building 251	Evaluation basis fire - No Action	10^{-6} to 10^{-4}	1.18×10^1	7.10×10^{-3}	1.22×10^3	7.34×10^{-1}	6.46×10^1	3.88×10^{-2}	4.52×10^3	2.71
	Evaluation basis fire - Proposed Action	10^{-6} to 10^{-4}	Same	Same	Same	Same	Same	Same	Same	Same
Building 331	Plutonium Metal Fire - No Action	10^{-6} to 10^{-4}	9.98×10^{-1}	5.99×10^{-4}	3.85×10^2	2.31×10^{-1}	7.52	4.51×10^{-3}	6.70×10^2	4.02×10^{-1}
	Aircraft crash with subsequent fire - Proposed Action	1.53×10^{-6}	3.26	2.28×10^{-4}	1.56×10^3	1.10×10^{-1}	2.55×10^1	1.79×10^{-3}	2.05×10^3	1.44×10^{-1}
Building 332	Aircraft Crash - No Action	4.86×10^{-6}	2.89	1.73×10^{-3}	1.19×10^3	7.14×10^{-1}	2.36×10^1	1.42×10^{-2}	2.53×10^3	1.52
	Room Fire Unfiltered - Proposed Action	3.90×10^{-7}	5.60	3.36×10^{-3}	2.17×10^3	1.30	2.98×10^1	1.79×10^{-2}	5.20×10^3	3.12

TABLE 5.5.1.2–2.—Potential Accident Frequency and Consequences (Unfavorable Meteorology)^a (continued)

Building	Accident	Frequency (per year)	Dose (rem)	MEI		Offsite Population ^b		Individual Noninvolved Worker		Noninvolved Worker Population	
				LCFs ^c		Dose (Person-rem)	LCFs ^d	Dose (rem)	LCFs ^c	Dose (Person-rem)	LCFs ^d
Building 334	Uncontrolled oxidation of plutonium at elevated temperatures - No Action	$< 1.00 \times 10^{-6}$	3.68	2.21×10^{-3}		1.03×10^3	6.18×10^{-1}	4.39×10^1	2.63×10^{-2}	2.08×10^3	1.25
	Uncontrolled oxidation of plutonium at elevated temperatures - Proposed Action	$< 1.00 \times 10^{-6}$	Same	Same		Same	Same	Same	Same	Same	Same
Building 581	Earthquake - No Action	2.00×10^{-8}	6.15×10^{-3}	3.69×10^{-6}		3.05	1.83×10^{-3}	1.33×10^{-2}	8.01×10^{-6}	2.22	1.33×10^{-3}
	Earthquake during plutonium Experiment without yield - Proposed Action	2.00×10^{-9}	2.16×10^{-2}	1.30×10^{-5}		8.33	5.00×10^{-3}	4.69×10^{-2}	2.82×10^{-5}	8.23	4.94×10^{-3}
Building 625	Aircraft Crash - No Action	6.10×10^{-7}	7.59	4.55×10^{-3}		5.80×10^3	3.48	2.70×10^1	1.62×10^{-2}	6.44×10^2	3.86×10^{-1}
	Aircraft Crash - Proposed Action	6.10×10^{-7}	2.31×10^1	1.39×10^{-2}		1.76×10^4	1.06×10^1	8.23×10^1	4.94×10^{-2}	1.96×10^3	1.18
Building 696R	Aircraft Crash - No Action	6.29×10^{-7}	1.66×10^1	9.93×10^{-3}		1.06×10^4	6.38	2.16×10^1	1.30×10^{-2}	1.73×10^3	1.04
	Aircraft Crash - Proposed Action	6.29×10^{-7}	Same	Same		Same	Same	Same	Same	Same	Same
Site 300 Materials Management Facilities	Depleted uranium release by fire - No Action	10^{-4} to 10^{-2}	7.89×10^{-3}	4.73×10^{-6}		2.60	1.56×10^{-3}	6.27×10^{-1}	3.76×10^{-4}	5.50×10^{-1}	3.30×10^{-4}
	Depleted uranium release by fire - Proposed Action	10^{-4} to 10^{-2}	Same	Same		Same	Same	Same	Same	Same	Same

TABLE 5.5.1.2–2.—Potential Accident Frequency and Consequences (Unfavorable Meteorology)^a (continued)

Building	Accident	Frequency (per year)	MEI		Offsite Population ^b		Individual Noninvolved Worker		Noninvolved Worker Population	
			Dose (rem)	LCFs ^c	Dose (Person-rem)	LCFs ^d	Dose (rem)	LCFs ^c	Dose (Person-rem)	LCFs ^d
Onsite Transportation	Radioactive and Hazardous Waste Management package explosion - No Action	$< 1.00 \times 10^{-6}$	7.73	4.64×10^{-3}	2.26×10^2	1.36×10^{-1}	1.43×10^1	8.58×10^{-3}	2.96×10^2	1.78×10^{-1}
	Radioactive and Hazardous Waste Management package explosion - Proposed Action	$< 1.00 \times 10^{-6}$	1.03×10^1	6.18×10^{-3}	3.01×10^2	1.81×10^{-1}	1.91×10^1	1.15×10^{-2}	3.94×10^2	2.36×10^{-1}
	Radioactive and Hazardous Waste Management Truck Fire - No Action	$< 1.00 \times 10^{-6}$	3.13	1.88×10^{-3}	8.10×10^2	4.86×10^{-1}	6.00	3.60×10^{-3}	5.53×10^2	3.32×10^{-1}
	Radioactive and Hazardous Waste Management Truck Fire - Proposed Action	$< 1.00 \times 10^{-6}$	Same	Same	Same	Same	Same	Same	Same	Same
	Materials Management Section package explosion - No Action	$< 1.00 \times 10^{-6}$	2.76	1.66×10^{-3}	6.50×10^2	3.90×10^{-1}	5.32×10^1	3.19×10^{-2}	1.02×10^3	6.12×10^{-1}
	Materials Management Section package explosion - Proposed Action	$< 1.00 \times 10^{-6}$	Same	Same	Same	Same	Same	Same	Same	Same

Source: Original

^a The consequences for the Reduced Operation Alternative would be the same as for the No Action Alternative.^b Based on the population of approximately 6,900,000 persons residing within 50 miles of LLNL.^c Increased likelihood of a latent cancer fatality.^d Increased number of latent cancer fatalities.

LCFs = latent cancer fatalities; MEI = maximally exposed individual.

For unfavorable meteorology, the bounding accident scenarios for each receptor are as follows:

- For the offsite population, the bounding accident for the Proposed Action is an aircraft crash into Building 625. This accident is estimated to result in 17,600 person-rem to this population, which would result in an additional 10.6 LCFs in this population. For the No Action Alternative, the bounding accident is an aircraft crash into Building 696R, which is estimated to result in 10,600 person-rem (6.4 LCFs).
- For the MEI, the bounding accident for the Proposed Action is an aircraft crash into Building 625. This accident is estimated to result in 23.1 rem to the MEI, which would result in a probability of 0.014 of the development of a fatal cancer. For the No Action Alternative, the bounding accident is an aircraft crash into Building 696R, which is estimated to result in a dose of 16.6 rem to the MEI (LCF probability of 0.0099).
- For the population of noninvolved workers, the bounding accident for the Proposed Action is a room fire (unfiltered) in Building 332. This accident is estimated to result in 5,200 person-rem to this population, which would result in an additional 3.12 LCFs in this population. For the No Action Alternative, the bounding accident is an evaluation basis fire in Building 251, which is estimated to result in 4,520 person-rem (2.7 LCFs).
- For an individual noninvolved worker, the bounding accident for the Proposed Action is an aircraft crash into Building 625. This accident is estimated to result in 82.3 rem to the noninvolved worker, which would result in a probability of 0.049 of the development of a fatal cancer. For the No Action Alternative, the bounding accident is an evaluation basis fire in Building 251 which is estimated to result in a dose of 64.6 rem to the noninvolved worker (LCF probability of 0.039).

Bounding Case Radiological Accident for Involved Workers

The bounding case radiological accident for involved workers is a plutonium criticality for a powder, slurry, or solution system in a workstation in Building 332. This accident has an estimated frequency of 3.2×10^{-5} per year. Severe worker exposures could occur inside the facility as a result of a criticality, due primarily to the effects of prompt neutrons and gammas. The methodology for determining these effects is presented in Appendix D, Section D.2.5, of this LLNL SW/SPEIS.

Personnel close to the criticality event (within the building) may incur prompt external exposures. Depending on distance and the amount of intervening shielding material, lethal doses composed of neutron and gamma radiation could be delivered. Some dose reduction could be achieved by immediate evacuation; however, most of the dose would be delivered within the response time of alarm instrumentation.

At a distance of 33 feet, the combined prompt gamma and neutron radiation dose to personnel from a plutonium powder criticality would be approximately 867 rem with no shielding and no evacuation. This dose is greater than the average lethal radiation dose to humans of approximately 450 rem. Thus, subsequent to a plutonium powder criticality, the potential for

lethal exposure exists, and on average, there may be two workers in a room who could be exposed to this radiation.

In the event of a criticality, the shielding of the laboratory interior walls and rapid evacuation from the laboratories would reduce doses to personnel not in the immediate vicinity of the criticality excursion.

5.5.2 Chemical Accident Scenarios

5.5.2.1 Methodology

Selection Process

The selection process for chemical accident scenarios used the same multistep screening process as described for radiological accidents in Section 5.5.1.1. Appendix D, Table D.2.5–1 of this LLNL SW/SPEIS, lists the results of this process and serves as the basis for the subsequent consequence analysis described below. The chemical accident scenarios analyzed are the same under the No Action Alternative, Proposed Action, and Reduced Operation Alternative.

Protective and Emergency Response Planning Guidelines

The adverse effects of exposure vary greatly among chemicals. They range from physical discomfort and skin irritation to respiratory tract tissue damage and, at the extreme, death. For this reason, allowable exposure levels differ from substance to substance. None of the chemicals of concern in the bounding accidents are known carcinogens. The standards used to evaluate bounding case scenarios are the Emergency Response Planning Guideline (ERPG) values established for each chemical by the American Industrial Hygiene Association. The ERPGs provide emergency response planners with estimates of the potential hazards associated with accidental releases of various toxic chemicals from LLNL facilities. The comparison to ERPGs is made when possible to provide estimates of the area where health effects would be the greatest. These ERPGs are intended to provide estimates of concentration ranges at which adverse effects can be expected if exposure to a specified chemical lasts more than 1 hour. The ERPG levels are defined as follows:

- ERPG-1 – The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing other than mild transient adverse health effects or perceiving a clearly defined, objectionable odor.
- ERPG-2 – The maximum airborne concentration below which it is believed that nearly all individuals could be exposed to up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair an individual's ability to take protective action.
- ERPG-3 – The maximum airborne concentration below which it is believed that nearly all individuals could be exposed to up to 1 hour without experiencing or developing life-threatening health effects.

If a chemical did not have published ERPG values, the temporary emergency exposure limits were used.

Consequence Analysis

Consequences of accidental chemical releases were determined using the ALOHA computer code (EPA 1999). ALOHA is an EPA/National Oceanic and Atmospheric Administration-sponsored computer code that has been widely used in support of chemical accident responses and in support of safety and NEPA documentation for DOE facilities.

The ALOHA code uses a constant set of meteorological conditions (e.g., wind speed, stability class) to determine the downwind atmospheric concentrations. The sequential meteorological data sets used for the radiological accident analyses were reordered from high to low dispersion by applying a Gaussian dispersion model, such as that used by ALOHA.

ALOHA contains physical and toxicological properties for approximately 1,000 chemicals. The physical properties were used to determine which of the dispersion models and accompanying parameters were applied. The toxicological properties were used to determine the levels of concern. Atmospheric concentrations at which health effects are of concern (e.g., ERPG-2) are used to define the footprint of concern. Because the meteorological conditions specified do not account for wind direction, since it is not known *a priori* in which direction the wind would be blowing in the event of an accident, the areas of concern are defined by a circle of radius equivalent to the downwind distance at which the concentration decreases to levels less than the level of concern.

5.5.2.2 Results

Tables 5.5.2.2–1 and 5.5.2.2–2 present the bounding chemical accident scenario for each of the evaluated facilities for median and unfavorable meteorological conditions, respectively. Table D.2.5–1 in Appendix D presents all of the analyzed scenarios for each LLNL facility, which provides the basis for the bounding facility accident scenarios presented in Tables 5.5.2.2–1 and 5.5.2.2–2.

Tables 5.5.2.2–1 and 5.5.2.2–2 show the building number and name, the scenario description, and results. The results presented include estimates of airborne concentrations of chemicals released during an accident and a comparison of these concentrations to the ERPGs. The results presented in Tables 5.5.2.2–1 and 5.5.2.2–2 apply to the No Action Alternative, the Proposed Action, and the Reduced Operation Alternative. Frequencies are presented in Appendix D, Table D.3.2–1 of this LLNL SW/SPEIS.

TABLE 5.5.2.2–1.—Potential Chemical Accident Consequences (Median Meteorology)

ERPG-2 Concentration (ppm)	ERPG-3 Concentration (ppm)	Noninvolved Worker		Site Boundary		ERPG-2 Distance (meters)
		Average Predicted Concentration (ppm)	Fraction of ERPG-2	Average Predicted Concentration (ppm)	Fraction of ERPG-2	
Building 191, High Explosives Application Facility – Chemical Dispersion (1,2-Dichloroethane)						
200	300	0.108	5.4×10 ⁻⁴	0.0175	8.8×10 ⁻⁵	11
Building 239, Radiography Facility – Toxic gas release (NO ₂)						
5	20	18.3	3.7	0.40	0.08	198
Building 322, Plating Shop – Multiple Container Liquid Spill (Hydrofluoric Acid)						
20	50	371	18.6	4.86	0.24	475
Building 331, Tritium Facility actinide activities – Nitric acid spill						
6	78	24	4	0.24	0.04	205
Building 332, Plutonium Facility – Chlorine release						
3	20	593	198	11.6	3.9	1,700
Building 334, Hardened Engineering Test Building – Toxic gas release (NO ₂)						
5	20	18.3	3.7	0.34	0.07	198
Building 514/612/625/693, Radioactive and Hazardous Waste Management Complex – Earthquake release of Freon-22						
7,500	7,500	415	0.06	169	0.023	19
Building 581, National Ignition Facility – Material Spill, Release of Nitric acid solution						
6	78	130	21.7	12.3	2.1	536
Site 300 Materials Management Facility – Hazardous materials release by fire (LiOH)						
1	102	1.42	1.42	0	0	119
Site 300 Explosive Waste Treatment Facility – Fire release of hydrogen fluoride						
20	50	28.1	1.41	0.097	0.049	119

^a These consequences apply to the No Action Alternative, the Proposed Action, and the Reduced Operation Alternative.
ERPG = Emergency Response Planning Guideline.

TABLE 5.5.2.2–2.—Potential Chemical Accident Consequences (Unfavorable Meteorology)^a

ERPG-2 Concentration (ppm)	ERPG-3 Concentration (ppm)	Noninvolved Worker		MEI		ERPG-2 Distance (meters)
		Average Predicted Concentration (ppm)	Fraction of ERPG-2	Average Predicted Concentration (ppm)	Fraction of ERPG-2	
Building 191, High Explosives Application Facility – Chemical Dispersion (1,2-Dichloroethane)						
200	300	1.41	7.1×10 ⁻³	0.272	1.4×10 ⁻³	11
Building 239, Radiography Facility – Toxic gas release (NO ₂)						
5	20	954	191	17.6	3.52	1,500
Building 322, Plating Shop – Multiple Container Liquid Spill (Hydrofluoric Acid)						
20	50	4,680	234	46.4	2.32	1,400
Building 331, Tritium Facility actinide activities – Nitric acid spill						
6	78	68	11.3	1.1	0.18	358
Building 332, Plutonium Facility – Chlorine release						
3	20	5,220	1,740	16.9	5.64	1,900
Building 334, Hardened Engineering Test Building – Toxic gas release (NO ₂)						
5	20	954	191	15.1	3.02	1,700
Building 514/612/625/693 Hazardous Waste Management Complex – Earthquake release of Freon-22						
7,500	7,500	4,080	0.54	1,312	0.17	75
Building 581, National Ignition Facility – Material Spill, Release of Nitric Acid Solution						
6	78	438	73	51.4	8.57	1,400
Site 300 Materials Management Facility – Hazardous materials release by fire (LiOH)						
1	102	59	59	0.151	0.15	865
Site 300 Explosive Waste Treatment Facility – Fire release of hydrogen fluoride						
20	50	1,168	58.4	2.98	0.15	860

^a These consequences apply to the No Action Alternative, the Proposed Action, and the Reduced Operation Alternative.
ERPG = Emergency Response Planning Guideline; MEI = Maximally Exposed Individual.

Bounding Accident Involving Chemical Releases and Impacts

The bounding accident for the onsite and offsite population for median meteorological conditions is the chlorine release from Building 332. For this accident, concentrations above the ERPG-2 level would exist as far out as 1.7 kilometers from Building 332, which would extend about 750 meters beyond the site boundary (the largest distance of any of the facility accident scenarios). At the site boundary, the concentration would be below ERPG-3 values, but above ERPG-2 values, indicating that members of the public exposed to this concentration could experience irreversible or other serious health effects or symptoms that could impair their ability to take protective action. At the noninvolved worker location, the concentration would be above ERPG-3 values, indicating that individuals exposed to this concentration could experience or develop life-threatening health effects. The workers inside the facility would be protected by the intact building structure and safety systems and thus would be unaffected by this incident.

For unfavorable meteorological conditions, the bounding accident is also the chlorine release from Building 332. Concentrations above the ERPG-2 level would exist as far out as 1.9 kilometers from Building 332, which would extend about 950 meters beyond the site boundary. At the site boundary, the concentration would be below ERPG-3 values, but above ERPG-2 values, indicating that members of the public exposed to this concentration could experience irreversible or other serious health effects or symptoms that could impair their ability to take protective action. At the noninvolved worker location, the concentration would be above ERPG-3 values, indicating that individuals exposed to this concentration could experience or develop life-threatening health effects.

5.5.3 High Explosive Accident Scenarios

5.5.3.1 Selection Process

The selection process for explosive accident scenarios used the same multistep screening process as described for radiological accidents in Section 5.5.1.1. Appendix D, Section D.4, lists the results of this process and serves as the basis for the subsequent consequence analysis described below.

5.5.3.2 Results

Table 5.5.3.2–1 presents the bounding explosive accident scenario for each of the evaluated facilities. Appendix D, Section D.4, presents all of the analyzed scenarios for each LLNL facility, which provides the basis for the bounding facility accident scenarios presented in Table 5.5.3.2–1.

Table 5.5.3.2–1 shows the building number and name, the scenario description, frequency, and an indication of the potential adverse impacts of the scenario. The impacts presented include estimates of the number of persons who might reasonably be present in the area near the accidental detonation and an indication of the acute impacts to these personnel. Also, where applicable, Table 5.5.3.2–1 provides a description of any impacts to personnel outside of the facility.

Bounding Case Accident Involving High Explosives

The bounding explosive accident is an accidental detonation at the Contained Firing Facility (CFF) or on an open air firing table. This accident would result in severe or fatal injury to personnel (normally 2 to 20) and, at the CFF, would result in significant building and equipment damage. This robust building is designed to confine the effects of this level of explosion, thus preventing any impact to noninvolved workers or the public.

TABLE 5.5.3.2–1.—High Explosive Accident Scenario Summary

Building and Name	Scenario Description	Frequency (per year)	Results
Site 300 Materials Management Facilities	Accidental detonation in an explosives assembly storage magazine.	10^{-6} to 10^{-4}	Severe injury or death to the immediate workers (normally two) and the destruction of the magazine, with possible injuries to nearby personnel within intraline and fragment distance, and damage to nearby facilities. Additionally, low-level environmental releases and low-level exposures of personnel to airborne hazardous materials would be lesser consequences. Onsite exposure to the resulting plumes would be below ERPG-3 levels. Offsite consequences would be limited to overpressures (impulse noise) and the potential for hazardous material exposures below ERPG-2 levels.
Site 300 Weaponization Program	Accidental bare explosives detonation in a test building with personnel present.	10^{-6} to 10^{-4}	Severe or fatal injuries to the immediate workers (normally two to five) and damage to the test equipment and building. Injuries to nearby personnel subjected to blast effects are also possible.
Site 300 Firing Areas	Accidental detonation at the CFF or on an open-air firing table.	10^{-6} to 10^{-4}	Severe or fatal injury to personnel (normally 2 to 20). An accidental detonation could result in significant damage to the facility and equipment at the CFF.
EMPC	Accidental detonation in an EMPC Assembly Bay.	10^{-6} to 10^{-4}	Severe or fatal injury to personnel (normally two to six) involved in assembling explosives and other components. Other personnel within the EMPC would not be injured.
Building 191 High Explosives Application Facility	Accidental detonation of explosives during contact operations.	10^{-6} to 10^{-4}	Personnel inside the room of occurrence (up to six people) could receive fatal injuries. Personnel outside the room of occurrence could also receive injury from overpressure effects (walls, mazes, and doors would preclude fragment hazards). Overpressure predictions outside the room of occurrence (but inside the facility) would be expected to result in some eardrum rupture. Lung damage would also be possible. There would be no blast effects (overpressure or fragments) outside the facility.

Source: Original.

EMPC = Energetic Materials Processing Center; CFF = Contained Firing Facility; ERPG = Emergency Response Planning Guideline.

5.5.4 Biological Accident Scenario

Microbiology laboratories are unique work environments that may pose special risks to personnel working within that environment. For purposes of this section, NNSA has selected a representative facility accident that has been previously analyzed by the U.S. Army in their *Final Programmatic Environmental Impact Statement Biological Defense Research Defense Program* (Army 1989). NNSA believes that this accident scenario is comparable to and bounds any potential scenarios associated with the proposed BSL-3 Facility, Building 368 at LLNL. Appendix D provides further details on this accident scenario.

The organism selected for this scenario is *Coxiella burnetii*, the rickettsial agent causing Q fever, a disease of varying degrees of incapacitation. *Coxiella burnetii* grows to high concentrations in chick embryos. It is a hardy organism that withstands laboratory manipulation with little or no loss in viability. It is highly stable in aerosol and undergoes a biological decay rate of about 1 percent per minute over a wide range of humidities. *Coxiella burnetii* is extremely infectious in a small particle aerosol.

This accident scenario involves an immunized laboratory worker processing *Coxiella burnetii*. In this scenario, the laboratory worker fails to use rubber O-rings to seal the centrifuge tubes, and all six bottles leak, allowing some of the slurry into the rotor, with some of the slurry also escaping into the centrifuge compartment that houses the rotor. The leakage of six bottles is highly improbable.

As shown in Appendix D, approximately 5×10^4 HID₅₀ (the term “HID₅₀” refers to the dose causing infection 50 percent of the time for man) could escape from the building exhaust stack. This is a conservative assumption as the facility would likely be required to have HEPA filters on the exhaust system. The quantity of human infectious doses, by simple Gaussian plume dispersion models, would dissipate to less than 1 HID₅₀ per liter of air in less than 2 meters from the stack, less than 0.1 HID₅₀ per liter of air at 16 meters, and less than 0.01 HID₅₀ per liter of air at 38 meters. Thus, this level of escape of *Coxiella burnetii* from the containment laboratory, even under the worst-case meteorological conditions, does not represent a credible risk to the noninvolved worker or offsite population.

The centrifuge operator would be at the greatest risk of becoming ill with Q fever. In opening the centrifuge, the infectious aerosol would be released initially and momentarily into a very confined area. The concentration of airborne infectious doses, seconds after the lid was opened, was calculated as 1.3×10^3 HID₅₀ per liter of air. Assuming that the centrifuge operator was in the area for no more than 5 minutes, the operator could have inhaled approximately 100,000 infectious doses. Previous studies cited reported that previously vaccinated men, when exposed to defined aerosols of 150 or 150,000 infectious doses of virulent *Coxiella burnetii*, did not consistently become ill (Army 1989). Since the centrifuge operator received about the same dose reported in these studies, it is uncertain whether the operator would become sick, since he was, by required procedures, immunized.

5.5.5 Offsite Transportation Accident Scenarios

Under the No Action Alternative, Proposed Action, and Reduced Operation Alternative, NNSA would transport radioactive materials, hazardous chemicals, explosives, and biological agents that could potentially be involved in accidents that release the cargo for exposure of the public. NNSA considers these accidents in this section to identify the bounding offsite transportation accident, its consequences, and its probability. The onsite transportation accidents are presented in Section 5.5.1.2 and Appendix D.

5.5.5.1 Radiological Transportation Accidents

Appendix J, Section J.4, of this LLNL SW/SPEIS examines the transport of special nuclear material, TRU waste, LLW, and tritium. For the Proposed Action, the bounding accident scenario involves special nuclear material (in this case, a fine oxide powder consisting primarily of plutonium isotopes). This accident was calculated to result in 2.7×10^4 person-rem, which corresponds to 16 LCFs. The probability of this accident is 5.3×10^{-11} per year and is not considered reasonably foreseeable. For the No Action Alternative and Reduced Operation Alternative, the bounding accident scenario involves 10 grams of gaseous tritium. This scenario is estimated to result in 338 person-rem, which is equivalent to 0.2 LCFs. The probability of this accident is 9.9×10^{-10} per year, which is also not reasonably foreseeable. Appendix J describes the methods by which these values were calculated.

5.5.5.2 Hazardous Chemical Transportation Accidents

Based on information in Appendix D, Section D.3, a transportation accident involving chlorine gas is likely to be the most severe, with the potential to cause death to individuals in the immediate vicinity. However, NNSA is examining only accidents involving transport by LLNL vehicles and personnel, i.e., those not involving materials delivered by common carrier or local vendors. For hazardous chemicals transported by LLNL, shipments of paint and lithium hydride are the most frequent. NNSA does not believe that these accidents would result in serious consequences other than those directly from the impact.

5.5.5.3 Explosives Transportation Accidents

Although LLNL does ship explosives offsite, the great majority of shipments with quantities sufficiently large to create a bounding accident are between Site 300 and the Livermore Site. Over 500 one-way shipments between the two LLNL locations per year are common. Approximately 30 shipments to the Nevada Test Site occur per year. LLNL uses packaging and operational controls to limit the probability of an accident occurring.

Should a sufficiently severe accident occur to detonate the explosives, potential impacts could be death or severe injury to the driver(s) and passengers in adjacent vehicles. Nearby buildings could be affected with projectiles providing the greatest hazard to any inhabitants. Secondary traffic accidents could affect individuals in vehicles not adjacent to the transport conveyance. Appendix D, Section D.4, examines explosives accidents in LLNL facilities for comparison.

5.5.5.4 *Biological Agent Transportation Accidents*

NNSA considered biological agent transportation accidents in its Environmental Assessment (EA) and Finding of No Significant Impact (FONSI) on the BSL-3 Facility (NNSA 2002e). This EA/FONSI concludes that accidents due to transportation of micro-organisms are not expected to increase over those under current conditions. The addition of milliliter-quantity samples shipped to and from the BSL-3 Facility through commercial or private courier would not be expected to change the overall incidence of risk of transportation accidents. Samples could consist of cells in media contained within U.S. Department of Transportation-certified packages. The consequences of such accidents would be anticipated to be minor.

5.5.6 *Multiple Building Accident Scenario*

5.5.6.1 *Methodology*

This section addresses the potential releases and consequences of a situation involving multiple source terms (both radiological and chemical) stemming from a single event affecting LLNL. The consequences of these releases will be assessed in the same manner as described previously.

An earthquake with a return period of 5,000 years (i.e., 2×10^{-4} per year) was postulated as the initiator for this accident scenario. This earthquake has an effective peak ground acceleration of approximately 0.8 g. As a rough comparison, the Livermore earthquakes on January 24 and January 27, 1980, recorded as 5.4 and 5.6 Richter Magnitude events, generated maximum measured peak ground accelerations of 0.26 g at a distance of 18 kilometers from the epicenter.

5.5.6.2 *Results*

This section provides a description of the radiological and chemical releases that may occur as a direct result of an earthquake. Scenarios and consequences are discussed in general terms only. For specific information concerning individual scenarios, refer to the referenced sections.

Radiological Releases

Under the multiple-building release scenario for the Proposed Action, the risk to the offsite MEI and to the population within 50 miles of LLNL is primarily attributable to releases from Buildings 251, 331, and 334. The offsite MEI for releases from these would not be at the same location. Therefore, summing the doses for each of the individual facilities is conservative. Taking this conservative approach results in a total radiation dose at the site boundary nearest to the release of 1.03 rem. Using the dose-to-risk conversion factor of 6×10^{-4} LCFs per person-rem, the MEI dose results in a 6.2×10^{-4} LCF probability.

The collective radiation dose to the approximately 6,900,000 people living within 50 miles of LLNL under the multiple-building release scenario was calculated to be 420 person-rem. Using the dose-to-risk conversion factor of 6×10^{-4} per person-rem, the collective population dose is estimated to result in an additional 0.25 fatal cancers to this population. The dose to the individual noninvolved worker was calculated to be 11.7 rem. This dose is estimated to have a 6.35×10^{-3} LCF probability (or 1 chance in 157) of the development of a fatal cancer.

The collective radiation dose to the population of noninvolved workers under the multiple-building release scenario was calculated to be 1,380 person-rem using the dose-to-risk conversion factor of 6×10^{-4} per person-rem. This collective dose is estimated to result in an additional 0.83 fatal cancers in this worker population.

Chemical Releases

Under the multiple-building release scenario, the risk at the site boundary would be dominated by the chlorine rupture and release from Building 332. For this accident, concentrations above the ERPG-2 level would exist as far out as 1.7 kilometers from Building 332, which would extend about 900 meters beyond the site boundary. At the site boundary, the concentration would be below ERPG-3 values, but above ERPG-2 values, indicating that persons exposed to this concentration could experience irreversible or other serious health effects or symptoms that could impair their ability to take protective action. At the noninvolved worker location, 100 meters from the release point, the concentration would be above ERPG-3 values, indicating that individuals exposed to this concentration could experience or develop life-threatening health effects. Health effects to involved workers are also anticipated to be life threatening.

The location of the highest site boundary concentration for releases from other facilities as a result of this earthquake would be at a different location than that for Building 332. The contribution from these other facilities at the location of highest site boundary concentration for Building 332 would be small and would provide a negligible contribution to the overall risk to an individual at this location.

5.5.7 Impacts of Postulated Accidents on Each Alternative

Under the No Action and Reduced Operation Alternatives, the potential exists for the accidental release of radioactive materials and hazardous chemicals, and the accidental detonation of explosives at several facilities during ordinary operations, during transportation, and as a result of an event affecting more than one facility. These accidents are summarized in Section 5.5 and detailed further in Appendix D. The Proposed Action described in Chapter 3 of this LLNL SW/SPEIS can affect the postulated accident scenarios for some of the facilities analyzed in this section.

For Building 331, under the Proposed Action, the material-at-risk value would increase from the current 3.5 grams of tritium to 30 grams. As described in Appendix D, during an aircraft crash with subsequent fire, the entire material-at-risk is assumed to be released to the environment. For the 30-gram material-at-risk under the Proposed Action, the collective dose to the population within 50 miles of LLNL was calculated to be 113 person-rem, which is estimated to result in an additional 0.068 LCFs in this population of approximately 6,900,000 people. Under the No Action Alternative, this collective dose would be approximately 13 person-rem, which is estimated to result in an additional 7.8×10^{-3} LCFs to the 50-mile population. Radiation dose and adverse health effects to the offsite MEI and the noninvolved worker would be similarly increased under the Proposed Action (i.e., from 0.019 rem [1.1×10^{-5} LCF probability] to 0.163 rem [9.8×10^{-5} LCF probability] and from 0.25 rem [1.5×10^{-4} LCF probability] to 2.11 rem [1.27×10^{-3} LCF probability], respectively).

Under the Proposed Action, the Building 332 material-at-risk limit would increase from the current 20 kilograms of 30-year fuel-grade equivalent plutonium to 40 kilograms for each of two rooms that support plutonium casting. For the Proposed Action, the bounding accident scenario is a room fire (unfiltered). For the No Action Alternative, the bounding accident scenario is an aircraft crash. Under the Proposed Action, the collective dose to the population within 50 miles of LLNL for the room fire (unfiltered) accident scenario was calculated to be 187 person-rem under median meteorological conditions, which is estimated to result in an additional 0.112 LCF in this population. Under the No Action Alternative, for an aircraft crash accident, the collective dose would be approximately 97 person-rem, which is estimated to result in an additional 0.058 LCF to the 50-mile population. Radiation dose to the offsite MEI and the noninvolved worker would be similarly increased under the Proposed Action (i.e., from 0.148 rem [8.9×10^{-5} LCF probability] to 0.29 rem [1.8×10^{-4} LCF probability] and from 1.84 rem [1.1×10^{-3} LCF probability] to 3.29 rem [2.0×10^{-3} LCF probability], respectively).

For the NIF, under the Proposed Action, tests would be conducted using plutonium targets. As shown above, the bounding accident for the NIF under the Proposed Action is an earthquake during a plutonium shot without yield shot. As described above, under the Proposed Action, the collective dose to the population within 50 miles of LLNL for this accident was calculated to be 0.55 person-rem, which is estimated to result in an additional 3.3×10^{-4} LCFs in this population. Under the No Action Alternative, this collective dose would be approximately 0.20 person-rem, which is estimated to result in an additional 1.20×10^{-4} LCFs to the 50-mile population. Radiation dose to the offsite MEI and the noninvolved worker would be similarly increased under the Proposed Action (i.e., from 4.78×10^{-4} rem [2.87×10^{-7} LCF probability] to 1.65×10^{-3} rem [9.9×10^{-7} LCF probability] and from 1.43×10^{-3} rem [8.58×10^{-7} LCF probability] to 4.99×10^{-3} rem [3.00×10^{-6} LCF probability], respectively).

For Building 625, under the Proposed Action, the source term for the bounding accident aircraft crash would increase from 0.46 plutonium-equivalent curies to 1.40 plutonium-equivalent curies. As described above, under the Proposed Action, the collective dose to the population within 50 miles of LLNL for the aircraft crash accident was calculated to be 2,020 person-rem, which is estimated to result in an additional 1.2 LCFs in this population. Under the No Action Alternative, this collective dose would be approximately 662 person-rem, which is estimated to result in an additional 0.40 LCF to the 50-mile population. Radiation dose to the offsite MEI and the noninvolved worker would be similarly increased under the Proposed Action (i.e., from 0.24 rem [1.44×10^{-4} LCF probability] to 0.73 rem [4.38×10^{-4} LCF probability] and from 0.65 rem [3.9×10^{-4} LCF probability] to 1.97 rem [1.18×10^{-3} LCF probability], respectively).

5.6 MITIGATION MEASURES

The regulations promulgated by the CEQ to implement the procedural provisions of NEPA (42 U.S.C. §4321) require that an EIS include a discussion of appropriate mitigation measures (40 CFR §1502.14[f] and 16[h]). The term “mitigation” includes the following (40 CFR §1508.20):

- Avoiding an impact by not taking an action or parts of an action
- Minimizing impacts by limiting the degree or magnitude of an action and its implementation
- Rectifying an impact by repairing, rehabilitating, or restoring the affected environment
- Reducing or eliminating the impact by preservation and maintenance operations during the life of the action
- Compensating for the impact by replacing or providing substitute resources or environments

This section describes mitigation measures by resource area, along with descriptions and key proactive initiatives. These mitigation measures and proactive initiatives address the range of potential impacts of the Proposed Action.

5.6.1 Defining Mitigation Measures

NNSA and LLNL operate under existing laws, programs, and controls, including regulations, policies, and contractual requirements. A list of laws, categorized by resource area, is presented in Chapter 7 of this LLNL SW/SPEIS. LLNL has numerous existing procedures that provide controls to mitigate potential impacts. Examples include the ES&H Manual, emergency plans, ISMS, Cultural Resources Management Plan, several protected species programs, and energy conservation and water reduction programs. In general, these procedures and controls effectively reduce the need for additional mitigation measures for resource areas evaluated in the LLNL SW/SPEIS.

This section summarizes potential impacts determined for each resource area and highlights major applicable laws, programs, procedures, and controls. If impacts are determined to be significant, mitigation measures are presented. Mitigation measures that are part of existing procedures and controls are not repeated. A more detailed description and implementation plan would be presented in a mitigation action plan published following the ROD. Agreements may be revised or amended based on future circumstances or changes in regulatory requirements.

5.6.2 Land Uses and Applicable Plans

LLNL does not plan to buy, sell, or transfer any property under the No Action Alternative, Proposed Action, or the Reduced Operation Alternative. All new construction would occur within the Livermore Site and Site 300, and the new facilities would be used for office space or R&D, as are all facilities at LLNL. Thus, there would be no changes in land use at LLNL, and no conflict with existing and approved future land uses adjacent to the site. Therefore, no additional mitigation measures would be required.

5.6.3 Socioeconomic Characteristics and Environmental Justice

The alternatives analyzed would cause changes in employment at LLNL ranging from a 5 percent increase under the Proposed Action to an 8 percent decrease under the Reduced Operation Alternative, as compared to the No Action Alternative. Commensurate changes in

LLNL direct expenditures, employee expenditures, and housing demand would result primarily within Alameda, San Joaquin, Contra Costa, and Stanislaus counties. Because of the large regional economy and the relatively small changes in employment under the alternatives, there would be minimal socioeconomic impacts from implementation of any alternative; no mitigation measures would be required.

LLNL operations analyzed would have minimal impact to resource areas analyzed, including human health effects to offsite residents or onsite workers. Therefore, no disproportionately high and adverse impacts to minority or low-income populations are anticipated and no mitigation measures would be required.

5.6.4 Community Services

LLNL operations under the alternatives analyzed would have minimal impact to the ability of nearby communities to provide fire protection, emergency services, police protection, school services, and nonhazardous solid waste disposal. The limited increase in the potential number of new laboratory workers would have minimal impact. Therefore, no mitigation measures would be required.

5.6.5 Prehistoric and Historical Cultural Resources

Mitigation measures to address impacts to prehistoric and historic cultural resources resulting from proposed LLNL activities are specific to each circumstance. The measures are determined by a number of factors, including the nature of the resource, the location of the resource, and the nature of the proposed activity. The Programmatic Agreement (see Appendix G) between NNSA, University of California, and the California SHPO describes the process to be followed to determine if specific proposed activities conducted at LLNL would have an effect on important prehistoric or historic cultural resources. If it is determined that a resource would be adversely affected, the Programmatic Agreement describes the process to be undertaken to address that impact, which can result in specific actions to avoid, reduce, or mitigate the adverse effect.

Unanticipated effects to resources can occur when previously unknown resources, namely subsurface cultural remains, are discovered during the activity. The Programmatic Agreement also addresses these “discovery” situations. It is unlikely that subsurface remains are present at the Livermore Site due to the disturbed nature of the area. Because of the undisturbed nature of Site 300, there is a greater potential for subsurface remains. If such remains are encountered during ground-disturbing activities, work within the immediate vicinity of the discovery would cease until consultation between NNSA and SHPO regarding the discovery has been completed. Through that consultation, a determination would be made of the resource’s importance, the extent of the effect, and appropriate actions required to avoid, reduce, or mitigate further adverse effect. The inadvertent discovery of Native American human remains or funerary objects (associated or unassociated) on LLNL would require adherence to the *Native American Graves Protection and Repatriation Act* (25 U.S.C. §3001).

No traditional cultural properties or Native American sacred sites have been identified on the Livermore Site or Site 300. If any are identified in the future, access to these properties or sites could become restricted. If access is desired, NNSA would consult with the appropriate Native American tribe to develop an agreement or procedures for access to the particular site.

5.6.6 Aesthetics and Scenic Resources

No impacts to aesthetics or scenic resources would occur under any of the alternatives addressed in this LLNL SW/SPEIS. Maintaining the visual quality of LLNL is accomplished through adherence to the Landscape Architecture Master Plan (LLNL 2002d). This Plan helps to create a cohesiveness of image for LLNL, and is intended to ensure that all site improvements are compatible with their immediate surroundings and that aesthetic qualities are enhanced. Any changes to LLNL and its built environment under the alternatives would be conducted in compliance with this Plan. Therefore, no additional mitigation measures would be required.

5.6.7 Geology and Soils

No known aggregate, clay, coal, or mineral resources would be adversely affected by any of the alternatives at either the Livermore Site or Site 300. None of the activities proceeding under any of the alternatives would take place near or upon any known or exploitable mineral resources, unique geologic outcrops, or other unique geologic features. None of the alternatives would impact farming or grazing. No mitigation measures would be required.

Under the alternatives analyzed, several facilities would be built in the undeveloped areas at the Livermore Site. A total of 700,000 square feet would be disturbed as a result of the construction that would proceed under the Proposed Action, including 240,000 square feet under the No Action Alternative. The soils that would be disturbed are not considered prime farmlands nor are they used for agriculture. Best management practices would be used to control runoff and soil loss. No additional mitigation measures would be required.

Under all of the alternatives, the wetland enhancement, described in Section 5.6.8, would involve the disturbance of 1.09 acres of soils at Site 300. Additionally, under the Proposed Action, approximately 33,000 square feet of previously undisturbed soils would be disturbed by the construction of the 40,000-square-foot EMPC. No additional mitigation measures would be required for disturbance of these soils.

5.6.8 Biological Resources

At the Livermore Site, measures would be taken to protect the California red-legged frog during Arroyo Las Positas Maintenance Project activities, as described in previously approved plans and the USFWS Biological Opinion (LLNL 1998a, USFWS 1998). These measures are summarized in Appendix E. A Bullfrog Management Program at the Livermore Site would continue to minimize the adverse impact of this known predator species of the California red-legged frog. A detailed description of this program coordinated with and approved by the USFWS is also provided in Appendix E. No additional mitigation measures would be required.

For Site 300, LLNL is proposing to mitigate the 0.62-acre artificial wetland, removed by continued operations at Site 300 under the No Action Alternative, Proposed Action, and Reduced Operation Alternative, by enhancing selected areas and increasing breeding opportunities for the California red-legged frog. A minimum of 1.86 acres (i.e., 3:1 replacement ratio) of wetland habitat would be enhanced and managed for these two species. Mitigation sites for enhancement include the wetlands at Mid Elk Ravine and the seep at the SHARP Facility. This mitigation measure has been previously addressed in a Biological Assessment and related Biological Opinion (Jones and Stokes 2001, USFWS 2002b). See Appendix E, Section E.2.1.9, for more information.

Measures to minimize impacts to the Alameda whipsnake at Site 300 are contained within a recent Biological Assessment and Biological Opinion (Jones and Stokes 2001, USFWS 2002b). Mitigation measures to minimize impacts to the California tiger salamander are provided in Appendix E. Continuing or proposed new activities at Site 300 are not anticipated to adversely affect the large-flowered fiddleneck, San Joaquin kit fox (which has not been observed since at least 1986), or the valley elderberry longhorn beetle as discussed in Appendix E. Therefore, no additional mitigation measures would be required.

5.6.9 Air Quality

Both the Bay Area and San Joaquin air basins are designated as nonattainment areas for ozone and respirable-sized particulates (PM₁₀). Because of this designation, emissions of particulate matter and ozone precursors such as oxides of nitrogen and precursor organic compounds are strictly regulated. Both the BAAQMD and SJVUAPCD have enacted “no net increase” programs, and are required to implement all feasible measures to reduce emissions of these pollutants. These include measures to control emissions from stationary sources (industrial, commercial, government, and research facilities), and offset any proposed increase in emissions by an equal or greater reduction in emissions. Site 300 is rated as a small source, and is not subject to offset requirements, which are generally placed on larger emitting sources. The Livermore Site is a mid-sized facility eligible for participation in BAAQMD’s offset management program.

LLNL requires stringent mitigation to minimize fugitive dust from construction activities. These include water spraying of disturbed areas and covering exposed piles of excavated material; and the use of engineering controls, devices, and work practices during work with asbestos to isolate the source of asbestos and prevent fiber migration.

Because fuel combustion sources are recognized as potentially significant sources of criteria pollutant emissions, LLNL has enacted standard measures to mitigate emissions from this source category (LLNL 2001s). These include the following:

- Fuels must meet the requirements of the *Clean Air Act Power Plant and Industrial Fuels Use Act*, and applicable DOE orders, and would continue to require that construction equipment and vehicles be inspected daily for leaks of fuel, engine coolant, and hydraulic fluid.
- Contract specifications for boilers require adherence to the American Society of Heating, Refrigerating and Air Conditioning Engineering, Inc., for energy efficiency, and compliance with efficiency standards is tested in accordance with American Society of Mechanical Engineers methods.
- LLNL also requires the use of late model, cleaner burning internal combustion diesel engines (Tier I or Tier II) for construction, and that construction equipment and vehicles be inspected daily for leaks of fuel, engine coolant, and hydraulic fluid.

LLNL has a transportation systems management program that provides and promotes alternative, environmentally responsible, options for employee commuting, assists LLNL in complying with transportation-related *Clean Air Act* legislation, and resolves congestion management issues (LLNL 2001s). LLNL would continue this program. No additional mitigation measures would be required.

5.6.10 Water

Water resources could be degraded by contaminant releases during construction of some facilities. Contaminant sources include construction materials; hydraulic fluid, oil, and diesel fuel; and releases from transportation of waste handling accidents. If a spill occurred, LLNL stormwater pollution prevention plans are in place to identify pollutant sources that affect the quality of industrial stormwater discharges and to describe implementation practices to reduce pollutants in the discharges. Necessary equipment to implement cleanup is available, and personnel are trained in proper response, containment, and cleanup of spills. Further guidance on response to hazardous material spills is provided in the ES&H Manual.

Compliance with the California General Construction Stormwater NPDES Permit (or other individual NPDES permit) for construction projects disturbing one acre or more, including developing and implementing a project-specific stormwater pollution prevention plan, would minimize impacts to surface waters from construction-induced erosion.

LLNL will continue to remove contaminants from groundwater and unsaturated zones (soil vapor) through a series of treatment facilities at the Livermore Site and Site 300. Groundwater quality should continue to improve because extracted groundwater will be collected and treated at the treatment facilities. No additional mitigation measures would be required.

5.6.11 Noise

At the Livermore Site, noise-generating activity levels and conditions are not expected to be significantly different from the No Action Alternative. With the relatively large spatial area and perimeter buffer zone, noise from most activities would not be expected to be discernible in offsite areas. Noise levels are not expected to conflict with land use guidelines, or adversely impact the offsite community. No additional mitigation measures would be required.

At Site 300, LLNL plans to continue high explosives research testing within the Contained Firing Facility and on open firing tables. The number of blasts and intensity are not expected to change, and therefore, impacts would be the same as the No Action Alternative. LLNL would continue to use blast forecasting as a tool to determine if explosive tests would adversely impact the surrounding community, and to restrict operations when peak impulse noise levels are predicted to exceed the 126 dBA-level in populated areas. LLNL would continue to perform meteorological monitoring to provide necessary input data for blast forecasting (LLNL 2001s). No additional mitigation measures would be required.

5.6.12 Traffic and Transportation

The traffic impacts for the No Action Alternative, Proposed Action, and Reduced Operation Alternative are not likely to be measurably different. Onsite and offsite radiological transportation impacts are very small, much less than one LCF over the period of analysis. NNSA will continue to conduct transportation operations in accordance with Federal and state regulations and will maintain procedures to ensure operations are safe, with radiological doses will be ALARA. Accordingly, no additional mitigation measures would be required.

5.6.13 Utilities and Energy

LLNL utilities and energy infrastructure is capable of accommodating demand under any of the alternatives. No mitigation measures would be anticipated.

Energy consumption is a particular concern in California based on past energy shortages. The California Independent System Operator forecasts adequate resources available to meet forecasted power demand and meet minimum operating reserves. The Independent System Operator also anticipates that the transmission should demonstrate adequate reliability performance during the projected peak demand periods. No mitigation measures beyond the energy management practices described in Appendix O would be required.

5.6.14 Materials and Waste Management

Under the Proposed Action, there would not be any major changes in the types of waste streams generated or materials used at LLNL. Waste generation projects would not exceed waste treatment and disposal capacities. Waste would continue to be managed in accordance with existing Federal and state regulations and with DOE/NNSA orders and guidance, and LLNL procedures. Therefore, waste management operations would be conducted in a manner to ensure protection of the environment and the safety of LLNL workers. LLNL has a waste minimization and pollution prevention program, described in Appendix O. This program has been effective in reducing the levels of waste generation and has established goals for future reductions of waste levels. No additional mitigation measures would be required.

5.6.15 Human Health and Safety

Under the No Action Alternative, the occupational worker dose would be 90 person-rem per year. This includes new facilities coming on line such as the NIF, and increased activities in the Superblock. The Proposed Action increases the total occupational dose to 93 person-rem per year. The Reduced Operation Alternative occupational worker dose would be 38 person-rem per year. Adverse human health effects to LLNL employees are not expected under any of the alternatives. Annual LCFs calculated for these levels of exposure are 0.054, 0.055, and 0.023, under the No Action Alternative, Proposed Action, and Reduced Operation Alternative, respectively.

LLNL has an ALARA program to minimize worker dose. Worker exposures are reviewed and trended quarterly. These trends provide the basis for control measures such as automating processes, adding remote operations, changed administrative procedures, and shielding improvements. Worker doses are monitored at frequent periods and evaluated to ensure that ALARA goals are being achieved or that timely corrective action is required.

It is the policy of DOE/NNSA and LLNL to operate in a manner that protects the health and safety of employees and the public. ES&H is a priority consideration in the planning and execution of all work activities at LLNL. LLNL complies with applicable ES&H laws, regulations, and requirements, and with directives promulgated by DOE regarding ES&H. LLNL ISMS provides a formal, organized process whereby LLNL personnel plan, perform, assess, and improve the safe conduct of work. The system defines a process for identifying, planning, and performing work that provides for early identification of hazards and associated control measures for hazards mitigation or elimination. The ISMS process also forms the basis for work authorization and provides for both internal and external assessment that provides a continuous feedback and improvement loop for identifying both shortcomings and successes for incorporation into subsequent activities. No additional mitigation measures would be required.

5.6.16 Site Contamination

Continued operation of LLNL under any of the alternatives carries the possibility of soil contamination and subsequent groundwater contamination; however, LLNL operational procedures minimize this potential. LLNL is required to continue its cleanup of existing contamination at both the Livermore Site and Site 300. Groundwater treatment and soil vapor extraction systems are in place to achieve these requirements. These systems will continue operation under the alternatives. Other than implementation of LLNL operational procedures, continued remediation, and cleanup milestones and goals already committed to by NNSA, no additional mitigation measures would be required.

5.6.17 Accidents

As detailed in Section 5.5, Bounding Accident Scenarios, there are postulated chemical and radiological accidents that potentially could result in onsite and offsite consequences. These accidents are similar for all alternatives. Management controls in the form of facility and operational safety procedures are used to minimize the probability of an accident and to reduce its consequences. However, in the event of an accident, LLNL has detailed response plans to further mitigate both the onsite and offsite consequences. DOE has developed an ISMS, a comprehensive approach to improving safety.

Protective Action Guide

A predetermined projected dose level at which specified actions should be taken to protect the public from exposure to radiation.

The ISMS includes: defining the scope of the work, identifying the hazards, establishing suitable controls, safely performing the work, and providing feedback for improvement. This ISMS is described in detail in Appendix C. The response activities would be closely coordinated with those of appropriate offsite emergency response organizations. Refer to Appendix I, Emergency Planning and Response, for further details. LLNL personnel are trained and drilled in the protective actions to be taken if a release of radioactive or toxic material should occur. These protective actions comply with protective action guides established by EPA (see Appendix I). The underlying principle for the protective action guides is that under emergency conditions all reasonable measures should be taken to minimize the radiation and chemical exposure to the general public and emergency workers. No additional mitigation measures would be required.

5.6.17.1 Emergency Response and Protective Actions

LLNL has detailed plans for responding to accidents of the type described here, and the response activities would be closely coordinated with those of local communities such as Alameda County. LLNL personnel are trained and drilled in the protective actions to be taken if a release of radioactive or otherwise toxic material occurs. Refer to Appendix I for further details on LLNL emergency planning and response information.

The underlying principle for the protective action guides is that under emergency conditions all reasonable measures should be taken to minimize the radiation exposure of the general public and emergency workers. In the absence of significant constraints, protective actions could be implemented when projected doses are lower than the ranges given in the protective action guides. No credit was taken from emergency response and protective actions in the consequence analysis. No additional mitigation measures would be required.

5.6.17.2 *High Efficiency Particulate Air Filtration*

In all areas where unconfined plutonium or other radioactive materials can be handled and can exist in a dispersible form, HEPA filters provide a final barrier against the inadvertent release of radioactive aerosols into the outside environment. However, these filters would not trap volatile fission products such as the noble gases and iodine; such gases would be released into the outside environment.

HEPA filter efficiencies are 99.99 percent or greater with the minimum efficiency of 99.97 percent for 0.3 micron particles, the size least efficiently captured by the filter. To maximize containment of particles and provide redundancy, two HEPA filters in series are used. Actual data from HEPA filter replacement records in Building 332 show that none of the filters used to prevent a potential for release of plutonium to the atmosphere have degraded to the overall efficiencies assumed for the accident scenarios (LLNL 2002r). These HEPA filters are protected by design features against the consequences of an earthquake or fire. Credit was taken for filtration in the consequence analysis when ventilation and building containment were shown by analysis to survive during the accident.